METROPOLITAN SEWER DISTRICT OF GREATER CINCINNATI

November 9, 2022

Chief, Enforcement and Compliance Assurance Branch
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ORSANCO
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RE: REVISED SSO 700 FINAL REMEDIAL PLAN BASED ON: INTERIM PARTIAL CONSENT DECREE ON SANITARY SEWER OVERFLOWS, GLOBAL CONSENT DECREE ON COMBINED SEWER OVERFLOWS, AND FINAL WET WEATHER IMPROVEMENT PROGRAM

Dear Reviewers:

Per the requirements of Section VI.C.3 of the Interim Partial Consent Decree on Sanitary Sewer Overflows (SSO CD) first lodged on February 15, 2002, and Section XV of the Consent Decree on Combined Sewer Overflows, Wastewater Treatment Plants and Implementation of Capacity Assurance Program Plan for Sanitary Sewer Overflows (Global CD) first lodged on December 3, 2003, as entered by the U.S. District Court for Southern District of Ohio Western Division on June 9, 2004, and the Final Wet Weather Improvement Program approved by Regulators in August 2010, as revised, the Metropolitan Sewer District of Greater Cincinnati (MSDGC), acting on behalf of the City of Cincinnati and the Board of County Commissioners for Hamilton County, submits the enclosed REVISED SSO 700 FINAL REMEDIAL PLAN. If a different individual should be the named recipient of this report for your agency, please contact Ben Gamble at 513-557-7162 or via email at Ben.Gamble@cincinnati-oh.gov.

In accordance with Section X.C of the SSO CD and Section XV.C of the Global CD, I hereby submit the following certification for this submission:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering such information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Sincerely,

11/09/2022

Diana R. Christy, Director
Metropolitan Sewer District of Greater Cincinnati

Date

c: Allen, Leslie – Chief, Environmental Enforcement Section – US Department of Justice
Aluotto, Jeff – County Administrator, Hamilton County
Anness, Charlie – Hamilton County Prosecutor
Ball, Karen – Hamilton County
Brumbaugh, David – Ohio EPA Central Office
Edelstein, David – Vorys, Sater, Seymour and Pease LLP
Fitzsimmons, Matt – Legal Aid Society of Greater Cincinnati
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McMahon, Louis L. – McMahon DeGulis LLP
Norman, Mark A. – Vorys, Sater, Seymour and Pease LLP
Richmond, Jenny – Deputy Director, MSD
Sherer, Erin – Ohio EPA Central District
Tapocsi, Emily Simmons – Chief, Environmental Enforcement Section – Ohio Attorney General's Office
Wall, Marilyn – Sierra Club
Welsh, Ryan – Deputy Director and Chief Engineer, MSD
Woerner, Emily – Deputy City Solicitor, City of Cincinnati Law Department
File

SSO 700

Final Remedial Plan

Metropolitan Sewer District of Greater Cincinnati

Original Submittal: 31 DECEMBER 2012

Revised: 09 NOVEMBER 2022

1 Executive Summary

This SSO 700 Final Remedial Plan was originally submitted in December 2012 by Defendants Hamilton County Board of County Commissioners and the City of Cincinnati, pursuant to and in fulfillment of requirements under the Interim Partial Consent Decree ("IPCD") and the Global Consent Decree, entered by the federal District Court on June 9, 2004, as well as the Revised First Amendment to the Consent Decree and the Final Wet Weather Improvement Plan ("Final WWIP"), approved by the federal District Court on August 10, 2010.

The Final WWIP required MSD to conduct a two-year study to evaluate effectiveness of the SSO 700 Interim Remedial Measures in conjunction with the LMC Study, to examine the potential use of green measures, and to examine the impact of upstream RDI/I work on SSO 700. MSD submitted the results of the study, along with a plan in accordance with the requirements of IPCD section VI.C.3 by December 31, 2012; that plan has been under review and discussion with the Regulators and this report represents an update to that plan, inclusive of completed work at the SSO 700 while also outlining additional/anticipated improvements to eliminate overflows in the SSO 700 basin.

Studies of the performance of SSO 700 have revealed that the SSO 700 STF has effectively eliminated a significant portion of overflows from SSO 700 that occurred prior to the facility construction and that this has resulted in marked improvements in water quality in the Mill Creek, as compared to pre-facility conditions. As described more fully in the instream Mill Creek water quality studies and the 2-year evaluation studies (2YES), the results from water quality modeling indicate that the treatment facility improves water quality at and downstream of the SSO 700 outfall.

The Final WWIP Phase 2 schedule and implementation plan was due on June 30, 2017 but was modified to be June 30, 2018 and the Co-defendants and Regulators agreed upon "bridge projects" that were to advance while Phase 2 was being negotiated. As noted, the reliability improvements at SSO 700 were advanced as a bridge project.

The SSO 700 FRP study revealed the interconnectedness of a final remedy at SSO 700 and the Lower Mill Creek Final Remedy ("LMCFR"). Taking this into consideration, the study resulted in two plan components as follows:

1.1 PLAN COMPONENT #1: SSO 700 STF RELIABILTY IMPROVEMENTS AND FACILITY OPTIMIZATION

As part of the 2012 SSO 700 FRP, MSD identified several improvements that were necessary to ensure the SSO700 STF could reliably operate as designed; this component was called the Reliability Improvements. Upon submission of the SSO 700 FRP, MSD continued to evaluate facility readiness. In 2013 MSD determined that instrumentation and controls (I&C) improvements were needed to be completed expeditiously. At that same time, enhancements were made to the operating strategies. Between 2014 – 2016 MSD launched its Wet Weather SCADA system with the deployment of remote sensor technology and reliable low-cost cellular communications to optimize facility operations. This included local optimization, basin optimization as well as automation of basin level optimization. As part of these optimizations the STF operating logic was modified to minimize/eliminate overflows at SSO 700 downstream of the facility. This was implemented by adding logic to modulate the diversion gate during wet weather to throttle flow while actively diverting flow to the STF. Logic was also programmed to detect and prevent flow from the downstream combined sewer area from backing up into the facility and overwhelming it. This was implemented by programming the PLC to detect backwater conditions and to close the diversion gate in response. The operating logic used two local assets - level sensors upstream and downstream of the diversion gate - to implement the aforementioned strategies to operate the diversion gate. The STF operating logic improvements included logic for automatically initiating and ending CEHRS treatment based on tank levels, facility state and influent pumps operation. The modifications also included logic for automatically initiating and ending dewatering of storage tanks based on tank and interceptor levels, CEHRS operation and facility state. All of these efforts are further outlined in Section 7.

In summary, MSD advanced the following three SSO 700 reliability upgrades (capital improvements include the items listed in table 7-1 of section 7.1) which were advanced in the first two projects listed below and the third project was advanced in the "bridge":

10241825 SSO 700 Operational Improvements Project
This project took care of the faulty instrumentation issues that kept the facility from sustaining reliable function. This project dealt with instrumentation and controls as well as relocating actuator electronics above ground.

10241820 SSO 700 Facility Improvements Project
This project completed the bulk of the items committed to in the FRP including the additional storage tank, additional coagulant storage tank, CEHRS solids pump station, new polymer system, and A/C upgrades for UV. This effort also provided a separation of the facility outfall so that discharges from CEHRS could be differentiated from storage tank overflows.

10142070 SSO 700 Disinfection Improvements Project
This project provided chemical disinfection for facility overflows from the additional tank that was installed in the previous project.

Storage and treatment operation continued throughout these construction activities with minimal interruption or missed events. Many of the improvements make the facility more reliable and better prepared for wet weather events. Addition of treatment chemical storage and replacement of obsolete equipment, such as the polymer system and UV, allow this facility to successfully operate today and into the future. Additional staffing has been added as well as initiating cross training of operations staff from other MSD facilities to further optimize performance.

1.2 PLAN COMPONENT #2: INTEGRATION WITH LOWER MILL CREEK FINAL REMEDY

The combined sewer flow contributions to the EBMCI create backwater conditions in the EBMCI that overflow combined sewage at the SSO 700 outfall. Even when the SSO 700 STF is treating upstream sanitary sewer system peak flows, the downstream flows from the combined sewer system back up and overflow at SSO 700. Increasing the capacity of the EBMCI alone will not solve the overall wet weather problem in the middle and upper Mill Creek Interceptor tributary sewer system. Just below the Hamilton County Fairgrounds, the limiting sewer capacity is approximately 32 mgd in the Mill Creek Interceptor (MCI). Storage and/or treatment facilities in the vicinity of the Hamilton County Fairgrounds would be needed to limit peak flows to the MCI from future relief sewers that may be needed to eliminate upstream SSOs.

Since submission of the FRP, there have been extensive discussions with the Regulators about the proper approaches for the Lower Mill Creek Partial Remedy (LMCPR) and Lower Mill Creek Final Remedy (LMCFR). In 2017, the East Branch Mill Creek Basin was calibrated using 2012 flow monitoring data. The calibration included hydraulic updates and information based on field measurements and simulated operations of the STF operation for each month during calibration.

As a result, the default FRP to eliminate sanitary sewage discharges from SSO 700 while completing WWIP requirements in the SSO 700 sewershed up to the 2-year storm have been determined. The plan that is referred to in various places in this document as the “default FRP,” “Default SSO 700 Final Remedy Plan” and “SSO 700 Final Remedy” constitutes the “SSO 700 Final Remedy Plan” required by the IPCD that Defendants will be required to implement following approval by the Regulators in accordance with Phase 2 scheduling unless it is later modified in accordance with the modification provisions of the consent decrees. The sizing of future default storage upstream of SSO 700 is shown in Section 7, Table 7-5. The default is a total storage volume of 24.8 MG that would be constructed in addition to and in connection with the LMCFR. In the watershed upstream of SSO 700, it may be noted that MSD anticipates using in-line storage from some of the existing WWIP projects. The existing in-line storage comes from the WWIP projects of Sharonville/Evendale Trunk Sewer to SSO 700, SSO 1048 Conveyance Sewer Phases 1 and 2, and SSO 587 Conveyance Sewer. These two future storage facilities would be activated by wet weather and would be dewatered by pumps and a force main back to the adjacent receiving sewer.

Under this FRP, dewatering of the SSO 700 tanks must be done in close coordination with the LMCFR so that both final remedies address how and when to dewater to maximize storage and conveyance to treatment at the Mill Creek WWTP. If capacity were available downstream, it would flow to the Mill Creek facility. If capacity were not available, it would be stored by the SSO 700 storage under this plan. MSD has invested significantly in its Wet Weather SCADA system and remote sensors which will continue to be useful for the purpose of managing flows as part of the SSO 700 FRP and LMCFR.

More detail of Component No. 2 is provided in Section 7.

2 Evolution of SSO 700 Remedial Plans

The Interim Partial Consent Decree, developed in 2002, focused solely on addressing Sanitary Sewer Overflows (SSOs) in the MSD system and did not address the combined sewer system that makes up most of the sewer system in the Mill Creek Basin. The outfall designated as SSO700 is located at the point where the sanitary sewer system and downstream combined sewer system meet, and at the time the IPCD was developed represented one of the largest overflows into the Mill Creek. The IPCD required MSD to design and implement an interim remedy as a demonstration of chemically-enhanced high rate treatment. That facility was constructed in compliance with the IPCD requirements and, as set forth below, has provided a considerable benefit to the water quality in the Mill Creek.

The IPCD was entered by the Court in 2004, at the same time a separate, "global" consent decree was entered. The Global Consent Decree did not directly address SSOs, including SSO700, but required MSD to develop a CSO Long Term Control Plan in parallel with the SSO Capacity Assurance Plan Program required under the IPCD. Through extensive analysis and continuing discussion with the Regulators, MSD ultimately developed a Final Wet Weather Improvement Plan that merged the LTCP and the CAPP into a single plan that enabled MSD to address CSOs and SSOs in a unified approach based on technical and economic feasibility and cost-effective "bundles" of geographically and hydraulically related projects. The merger of the LTCP and the CAPP into the Final WWIP was approved by the Court on August 10, 2010. The Final WWIP required Defendants to submit a final remedial plan (FRP) for SSO 700 before December 31, 2012 and coordinate it with the work of the Lower Mill Creek Study, which was also due by December 31, 2012. The goal of the FRP is to eliminate sanitary sewage overflow from the outfall at SSO 700, in accordance with the scheduling provisions of Phase 2 of the Final WWIP, the Consent Decree, the National CSO Policy, the Clean Water Act, and EPA's Integrated Planning Framework, published in June 2012.

On December 31, 2012, the SSO 700 Final Remedial Plan was initially submitted pursuant to and in fulfillment of requirements under the Interim Partial Consent Decree and the Global Consent Decree, entered by the federal District Court on June 9, 2004, as well as the Revised First Amendment to the Consent Decree and the Final Wet Weather Improvement Plan, approved by the federal District Court on August 10, 2010. Following extended discussions between the Defendants and the Regulators to agree upon a default project that represents a viable final remedy for sanitary sewage overflows from the outfall designated as SSO 700, this document was revised to update, clarify and supersede the SSO 700 FRP submitted on December 31, 2012 by the Defendants to the Regulators in compliance with and fulfillment of the federal Consent Decrees.

3 LMC Study and SSO 700 FRP Coordination

The Final WWIP requires that alternatives to the LMCPR also must address the concepts for a Lower Mill Creek Final Remedy. In undertaking that evaluation, Defendants were required to identify viable LMCFR concepts for the Mill Creek system that would be addressed after Phase 1. Because the issues relating to overflows at the SSO 700 outfall were intimately connected to the lack of capacity in EBMCI, and because this sewershed was undergoing the LMC Study, the Defendants and Regulators in the Final WWIP also expressly connected the development of this SSO 700 FRP to the LMC Study.

The 2006 WWIP submitted by Defendants in compliance with the Global Consent Decree focused on measures in the headwater and sensitive streams in the Little Miami and Muddy Creek watersheds due to community priorities and limitations on time and affordability. During the course of continuing discussions, the Regulators identified an emphasis on control measures in the Mill Creek basin, where the majority of the MSD system overflows occurred. The parties agreed upon a "phased" Final WWIP, where Phase 1 would include a Lower Mill Creek Partial Remedy (LMCPR). Because the Mill Creek basin and its proposed conceptual control measures had not been studied in the detail that the other basins had been, and because the estimated costs of the LMCPR were very significant, the Defendants and Regulators agreed in the Final WWIP to a three-year study period to review the Mill Creek system in greater detail and examine control approaches and measures as alternatives to the default projects listed in the WWIP.

It was understood that the Mill Creek system required additional study because it is a complex, interconnected system served by interceptor sewers that are overloaded with wet weather and combined sewer flow. Because of that complexity, several identified projects required detailed investigation and analysis to determine cost-effectiveness and coordination within the system. Furthermore, the potential benefits and cost savings from examination of new approaches, such as source control, sustainable and green infrastructure, new technologies and consolidating disparate projects together, had never been fully analyzed to achieve the most effective and cost- effective control measures possible.

The LMC Study and its extensive supporting record are available separately. Relevant elements of that study, such as the updating of the system hydraulic and hydrologic model to achieve a much greater accuracy, and the voluntary development of a Mill Creek water quality model, are discussed in this report.

While actual final measures for any LMCFR will be planned, designed and constructed in accordance with the terms of the Final WWIP, the LMC Study has identified two critical facts relevant to SSO700:

- The updated system-wide modeling and the new water quality modeling show a marked improvement in Mill Creek water quality from the existing SSO700 STF demonstration facility and the upgrades to that wet weather facility that enhanced reliability and capacity.
- There is no technologically or economically feasible measure that eliminates overflows from the SSO 700 outfall in isolation from measures that address other outfalls and the backwater condition in the Lower Mill Creek combined sewer system.

3.1 MODEL UPDATES

For a complete discussion of the MSD update from a kinematic model to a dynamic model, as well as MSD's development of a Mill Creek water quality model, please see Lower Mill Creek Water Quality Analysis-Initial Results prepared by LimnoTech for MSD, April 2012. The modeling discussions below are focused specifically on the SSO 700 STF and the outfall and their impact on the Lower Mill Creek.

3.1.1 Collection System Modeling

A collection system model is an integral part of determining the future projected flows that are to be managed at or near the SSO 700 STF. A specific modeling task for SSO 700 was therefore conducted for MSD to evaluate current hydraulic conditions and future hydraulic conditions after upstream improvement projects have been implemented. The modeling task consisted of calibration and validation of the current version of the Mill Creek System Wide Model (SWM). This modeling task included portions of the MSD sewer system upstream of the SSO 700 STF and approximately two miles downstream along the interceptor. The modeling task also included a modeling evaluation of current and future scenarios which impact or may impact flows to the SSO 700 STF.

3.1.1.1 Model Calibration and Validation (Black & Veatch 2012)

The Mill Creek SWM provided for this study was originally developed as part of the 2003 System Wide Model Development (MSDGC, 2003). The SWM has undergone subsequent revisions as part of ongoing maintenance and project work within the Mill Creek sewer system. An overview of the entire Mill Creek SWM with the East Branch Mill Creek portion of the model outlined in red is shown in Figure 3-1.

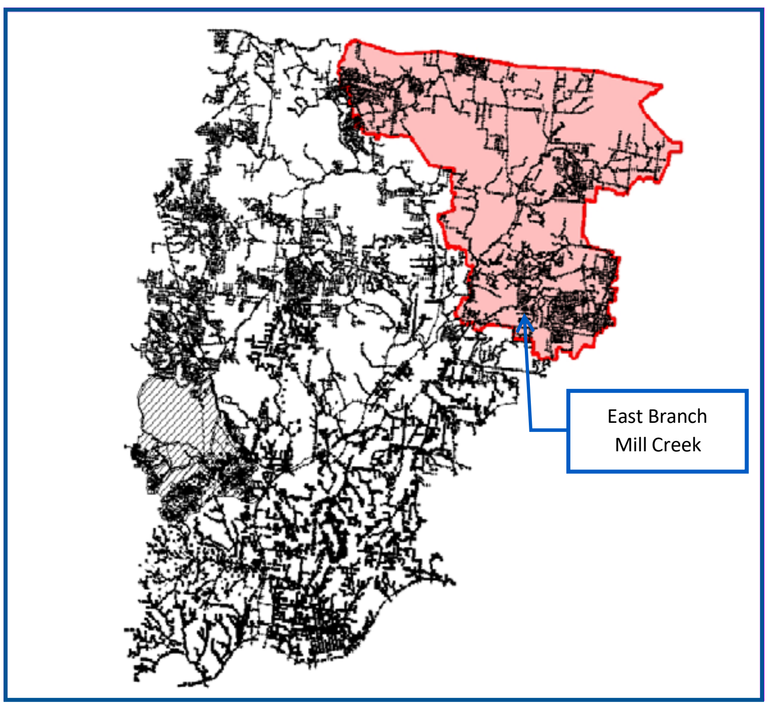


Figure 3-1. Mill Creek SWM Overview

For the model calibration and validation task, only the portion of the model near SSO 700 was evaluated. This portion of the model is shown in Figure 3-2.

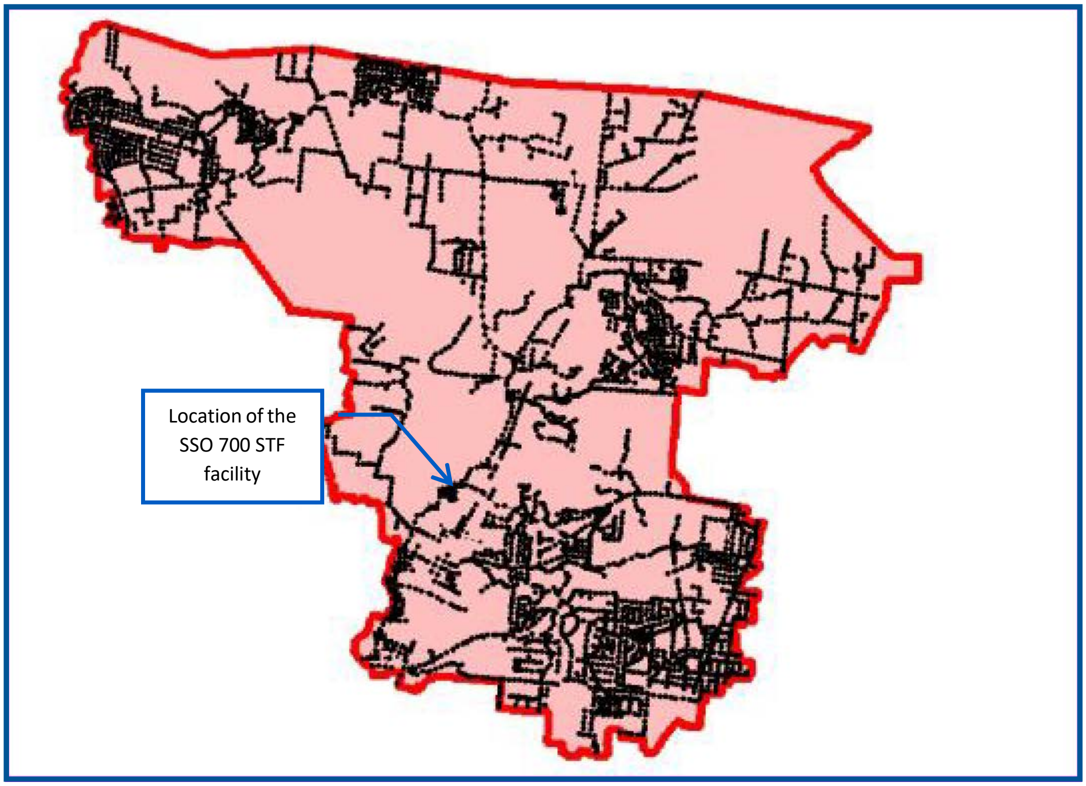


Figure 3-2. Portion of Mill Creek SWM for Calibration and Validation Task

The data utilized for this task consisted of rainfall data that was supplied from MSD's calibrated radar-rainfall information for the time period of January 1, 2009 to March 31, 2010. In addition to the rainfall data, flow data from the same time period was needed as well. Flow and depth data utilized for this task consisted of data from MSD's flow monitoring network of 11 flow meters sites near SSO 700. The locations of these flow meter sites are shown in Figure 3-3, below.

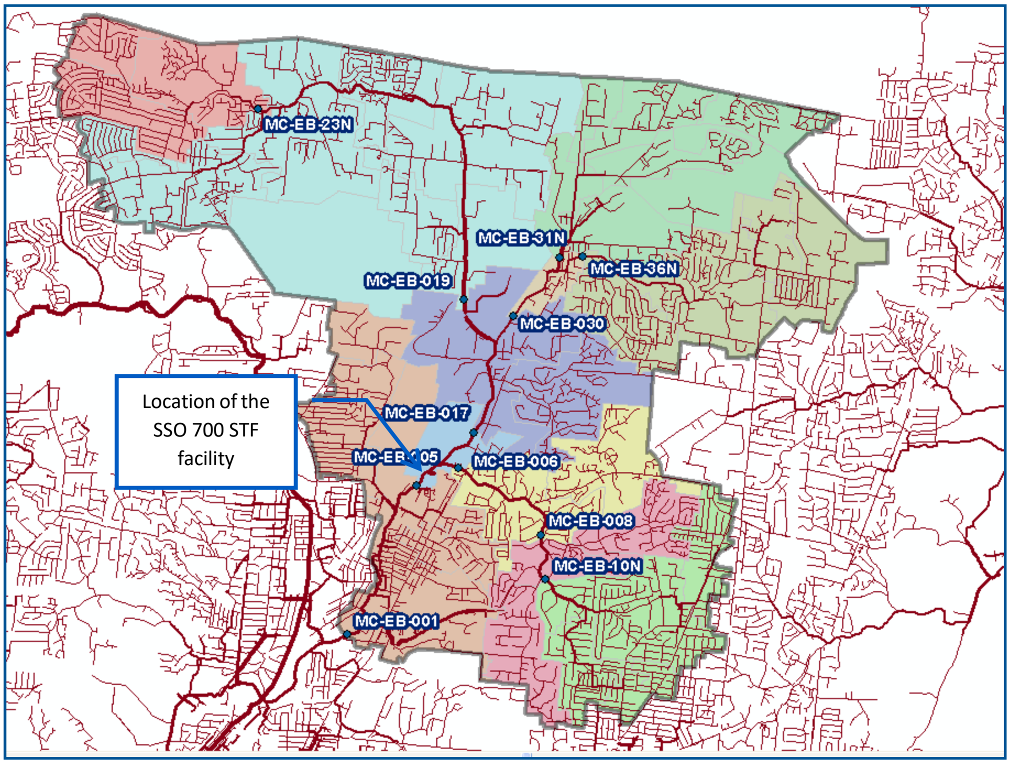


Figure 3-3 Flow Meters Used for Calibration and Validation

From the rainfall and flow data, dry weather periods and wet weather events were identified and are documented in the EMBC Model Calibration and Validation Technical Memorandum (Black & Veatch, 2012). An evaluation of the flow metering data collected indicated that three of the flow meter sites were not consistent with the other flow meters in the basin. Eight of the flow meters were therefore used for the calibration and validation task.

The calibration consisted of evaluating three dry weather periods and three wet weather events. Adjustments to the model for the dry weather calibration consisted of average dry weather flow adjustments and the addition of hourly diurnal patterns. After adjusting the dry weather portion of the model, the wet weather calibration consisted of adjusting the Real Time Kinetic (RTK) parameters that affect the RDI/I. After the calibration, two other dry weather periods and two other wet weather events were selected as validation events. The results of the dry weather model calibration and validation are presented in Table 3-1 and Table 3-2; while the wet weather calibration results are presented in Table 3-3 and Table 3-4. Table cells that are filled in yellow indicate those results that were within the range of accuracy recommended within MSD's Modeling Guidelines and Standards (MSDGC, 2011). Percentages shown represent the 'percent bias' (a statistical index showing how far the simulated value is from the measured one).

Table 3-1. Dry Weather Calibration and Validation Results for Flow Meters MC-EB-36N, MC-EB-31N, MC-EB-23N, and MC-EB-10N

	MC-EB-36N				MC-EB-31N				MC-EB-23N				MC-EB-10N			
	Event	Peak Flow	Volume	Depth	Event	Peak Flow	Volume	Depth	Event	Peak Flow	Volume	Depth	Event	Peak Flow	Volume	Depth
Calibration	DW Period 15	-2.1%	4.8%	10.2%	DW Period 23	-0.1%	1.6%	-3.3%	DW Period 5	1.8%	4.7%	-0.5%	DW Period 18	-2.6%	3.1%	-2.3%
	DW Period 23	-5.4%	-9.5%	3.5%	DW Period 1	-0.5%	-8.1%	-2.2%	DW Period 22	-2.7%	-7.3%	0.5%	DW Period 15	5.4%	3.4%	-2.5%
	DW Period 16	-9.0%	-7.2%	2.2%	DW Period 15	6.5%	-5.5%	-0.7%	DW Period 23	-4.5%	2.8%	-6.1%	DW Period 23	-7.4%	1.6%	-2.5%
	Criteria met	3	3	3		3	3	3		3	3	3		3	3	3
Validation	DW Period 20	-10.7%	-3.2%	-1.2%	DW Period 14	-9.2%	-6.7%	-5.7%	DW Period 24	-0.5%	-7.5%	3.5%	DW Period 20	-11.8%	-6.4%	-7.5%
	DW Period 10	7.0%	4.3%	11.8%	DW Period 18	9.0%	-9.5%	1.4%	DW Period 11	5.4%	10.9%	-7.9%	DW Period 13	-13.5%	3.0%	-6.9%
	Criteria met	1	2	1		2	2	2		2	1	2		0	2	2

Table 3-2. Dry Weather Calibration and Validation Results for Flow Meters MC-EB-008, MC-EB-030, MC-EB-019, and MC-EB-001

	MC-EB-008				MC-EB-030				MC-EB-019				MC-EB-001			
	Event	Peak Flow	Volume	Depth	Event	Peak Flow	Volume	Depth	Event	Peak Flow	Volume	Depth	Event	Peak Flow	Volume	Depth
Calibration	DW Period 15	-3.6%	-3.1%	0.5%	DW Period 18	4.2%	-2.1%	-3.1%	DW Period 18	2.2%	1.5%	6.7%	DW Period 9	0.8%	0.5%	-0.3%
	DW Period 20	-3.6%	-3.7%	1.9%	DW Period 24	2.7%	2.0%	-4.7%	DW Period 11	-5.7%	-4.3%	3.1%	DW Period 14	-0.4%	2.7%	1.4%
	DW Period 14	3.5%	5.7%	5.0%	DW Period 1	4.6%	-5.4%	-2.1%	DW Period 6	-4.0%	-2.7%	8.6%	DW Period 13	-3.3%	0.8%	1.2%
	Criteria met	3	3	3		3	3	3		3	3	3		3	3	3
Validation	DW Period 18	1.2%	-8.4%	7.7%	DW Period 16	3.7%	6.8%	-3.5%	DW Period 9	-8.6%	4.9%	6.3%	DW Period 15	-2.0%	3.5%	0.7%
	DW Period 16	-8.6%	-9.3%	-1.0%	DW Period 7	4.2%	-4.0%	7.6%	DW Period 20	5.2%	8.6%	6.5%	DW Period 6	4.8%	0.7%	0.4%
	Criteria met	2	2	2		2	2	2		2	2	2		2	2	2

Table 3-3. Wet Weather Calibration and Validation Results for Flow Meters MC-EB-36N, MC-EB-31N, MC-EB-23N, and MC-EB-10N

	MC-EB-36N				MC-EB-31N				MC-EB-23N				MC-EB-10N			
	Event	Peak Flow	Volume	Depth	Event	Peak Flow	Volume	Depth	Event	Peak Flow	Volume	Depth	Event	Peak Flow	Volume	Depth
Calibration	Event 62	-10.5%	-2.1%	-1.8%	Event 34	6.7%	3.1%	-7.2%	Event 13	-4.1%	-2.9%	-4.8%	Event 48	18.4%	20.5%	-6.1%
	Event 19	-1.3%	10.1%	13.8%	Event 64	2.9%	-8.3%	-10.2%	Event 104	13.7%	-4.3%	3.8%	Event 19	-28.2%	-29.1%	2.3%
	Event 44	13.9%	3.9%	10.6%	Event 29	21.4%	-0.5%	-3.4%	Event 81	-9.1%	0.3%	-12.0%	Event 62	16.7%	36.7%	-5.7%
	Criteria met	3	3	3		3	3	3		3	3	3		2	1	3
Validation	Event 47	5.0%	16.3%	14.3%	Event 81	25.2%	-6.5%	-0.1%	Event 73	5.3%	14.0%	2.1%	Event 21	-12.6%	-24.2%	31.1%
	Event 81	-3.4%	-14.2%	-2.4%	Event 62	19.0%	18.6%	7.1%	Event 21	-8.0%	-13.3%	2.0%	Event 68	24.1%	36.2%	6.0%
	Criteria met	2	1	2		1	2	2		2	1	2		2	0	2

Table 3-4. Wet Weather Calibration and Validation Results for Flow Meters MC-EB-008, MC-EB-030, MC-EB-019, and MC-EB-001

	MC-EB-008				MC-EB-030				MC-EB-019				MC-EB-001			
	Event	Peak Flow	Volume	Depth	Event	Peak Flow	Volume	Depth	Event	Peak Flow	Volume	Depth	Event	Peak Flow	Volume	Depth
Calibration	Event 35	4.7%	0.6%	3.5%	Event 64	10.2%	1.5%	-11.4%	Event 81	2.0%	-3.7%	5.3%	Event 21	-0.7%	-1.8%	0.3%
	Event 81	5.5%	-1.8%	7.7%	Event 81	16.9%	-1.2%	-3.1%	Event 72	1.3%	3.1%	-12.4%	Event 35	3.5%	-0.2%	0.2%
	Event 34	-10.9%	5.7%	-3.3%	Event 34	22.7%	14.2%	-0.7%	Event 21	-5.4%	-13.6%	9.5%	Event 104	-3.5%	-1.8%	0.2%
	Criteria met	3	3	3		3	3	3		3	2	3		3	3	3
Validation	Event 72	1.7%	2.5%	13.7%	Event 29	21.7%	14.8%	-5.4%	Event 29	8.8%	2.2%	16.8%	Event 34	-2.9%	5.5%	0.0%
	Event 29	-9.4%	-7.5%	-12.3%	Event 93	-8.1%	-7.6%	-15.6%	Event 93	8.2%	24.4%	7.2%	Event 44	6.3%	2.8%	0.1%
	Criteria met	2	2	2		2	2	1		2	1	1		2	2	2

3.1.1.2 Baseline Scenario Evaluation

A baseline modeling evaluation was performed to represent the then current state of the MSD sewer system. The baseline condition represents the current condition of the Mill Creek sewer system near SSO 700, as previously described. This version of the model was created from the model provided by MSD, but additional calibration and validation of the model was performed by Black & Veatch for the portion of the model upstream of flow meter MC-EB-001 (which includes the SSO 700 STF and SSO 700 outfall).

The baseline simulation identified an issue in the upstream section of the model at MH 43503007, at the point where a 66-inch and a 30-inch sewer connect to a downstream 39-inch sewer, where a significant amount of flow was unintentionally leaving the sewer system (i.e. flooded manhole condition). The key results from the baseline simulation are presented in Table 3-5.

Table 3-5. Baseline Model Results

	Dry Weather	2-yr design storm	10-yr design storm
Peak Flow (MGD) Leaving SSO 700 STF			
Baseline	0	6.63	10.23
Volume (MG) Leaving SSO 700 STF			
Baseline	0.0	0.429	0.955
Total Number of MHs Flooded Upstream of SSO 700 STF			
Baseline	0.0	51	79
Sum of MH Flooded Volume (MG) Upstream of SSO 700 STF			
Baseline	0.0	24.2	45.1
Total Number of SSOs Discharging Upstream of SSO 700 STF			
Baseline	0.0	4	6
Total SSO Volume (MG) Upstream of SSO 700 STF			
Baseline	0.0	1.2	3.1

The results for the baseline indicate that there is a significant amount of flow that leaves the system upstream of SSO 700 as both identified SSOs and as un-controlled manhole flooding. This scenario is the best estimate of the flows that would be in the sanitary sewer as it existed for the 2012 study. Since a portion of the storage at the SSO 700 STF needs to be dedicated to solids storage, the facility treatment capacity that would be required to eliminate overflows for the 2-year design storm at SSO 700 STF in its initial configuration was determined to be 66 cfs, or 43 mgd.

3.1.1.3 East Mill Creek Basin IWAP (Jacobs 2018)

With the information developed in the Black & Veatch study above, MSD moved to conduct an Integrated Watershed Master Plan. The plan was to update and more finely calibrate the model and then use the model to develop solutions to overflows and flooding MHs. The first steps in developing the plan were the flow monitoring and model calibration. This effort used 13 flow monitors throughout the East Mill

Creek Basin. The recalibrated model and proposed solutions were used for future development of the Final Remedy. The details of this recalibration are discussed further in Section 7.3 below.

3.1.1.4 WWIP and Flooding MH Elimination Sizing

The next phase of developing the SSO 700 final remedies was to install proposed WWIP projects intended to eliminate SSO discharges and flooding MHs. The projects were primarily to upsize pipes for conveyance downstream for treatment. Where additional flooding MHs were modeled, either as new issues or a consequence of WWIP projects, additional pipe segments were upsized to convey all flows to the SSO 700 STF. The resultant pipes conveyed too much volume and too high a peak flow for SSO 700 STF to store or treat and exceeded capacity at the SSO 700 diversion structure. This lack of capacity caused a backwater which overflowed at MHs near SSO 700.

3.1.1.5 SSO 700 Site Solutions

The model file was modified to test for size of needed storage if the 2-year storm would be captured at SSO 700 for treatment either through the CEHRS or discharge to the interceptor to the WWTP. An oversized fourth tank was added with the control rules set to fill the fourth tank when the original three tanks are full. This future scenario assumed that the CEHRS would be decommissioned.

With the STF pumping at the current 30 MGD the STF stored 21.7 MG for the 2-year storm. Additionally, 10.9 MG flowed over the isolation gate at the facility into the downstream combined sewer system and MH 43309006 flooded 1.4 MG. During the full duration of when the upstream system was releasing flow to the combined sewers, SSO 700 outfall was discharging 5.2 MG.

Given the volumes and flow rates needed to be stored or treated, the SSO 700 STF site was determined to be too small with significant hurdles to expansion. Beyond expanding the combination of storage and CEHRS capacity to deal with the volumes required, the pump station would have to be expanded to lift the peak flow from the interceptor to the STF.

3.1.1.6 SSO 700 Off-site Storage

The alternative to on-site storage for SSO 700 STF was off-site storage attached to the interceptors. The default model scenario for the off-site storage was to assume buried tanks for interceptor overflow (no pumps) into the tank. The tanks would then be pumped to the local interceptor as interceptor capacity allowed. One advantage to this storage operation was pumps smaller than SSO 700 STF could be used due to the lower flow rates and lower heads needed.

For storage facilities located off the SSO 700 STF site, a desktop search was made for large undeveloped properties adjacent to the largest interceptors possible. One site near the STF was found on the Cooper Creek Interceptor. The second site was further north on the Springdale Sharonville sewer.

Planning level modeling was performed to determine the storage sizes needed to meet three goals:

1. Keep SSO 700 STF at its current treatment rate and storage at four tanks

2. Prevent flooding manholes

3. Isolate upstream from the downstream combined sewer to prevent sanitary sewage overflows from SSO 700.

This scenario is discussed in more detail in Section 7.3 below.

3.2 LMC STUDY CONFIRMS SSO700 REQUIRES REGIONAL SOLUTION

The integrated nature of SSO700 to the Mill Creek interceptor system is illustrated in analyzing a storage option for just that outfall. As demonstrated by the modeling, in order to capture all upstream flow at the SSO 700 outfall (and ignoring that combined sewer backwater component of that overflow), more than 21 MG of storage would be needed. The existing site is constrained by the Mill Creek and railroad tracks in accommodating the footprint of additional tanks. Other nearby property is not available or faces considerable environmental challenges and liabilities. More importantly, the EBMCI interceptor in a typical year does not have sufficient capacity to dewater the volume stored at that location before either the stored flow becomes septic or flow from another storm would arrive. Review of RDI/I studies and upstream collection system issues also revealed that traditional measures to “tighten” the upstream collection system, including implementing some SSO projects identified in the Final WWIP, will actually increase that flow to the SSO700 location.

Final remedies for overflows at SSO700 cannot be separated from the questions of Mill Creek interceptor capacity that will ultimately be resolved in the Lower Mill Creek Final Remedy.

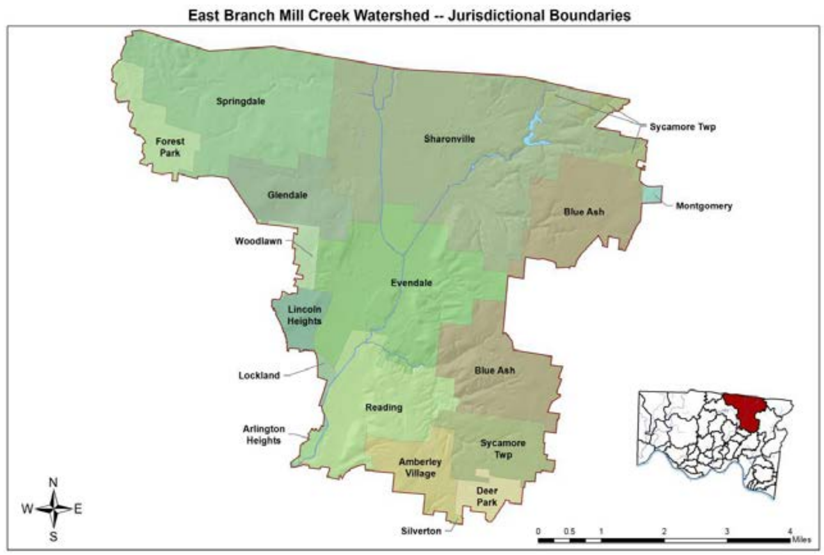
3.3 RDI/I WORK UPSTREAM OF SSO 700

Nearly all of the tributary area upstream of SSO 700 has been the subject of several RDI/I studies completed in the 1990s. The RDI/I studies included manhole inspections, smoke testing, TV inspection, and dye testing. The RDI/I studies identified private property remedial measures needed to mitigate infiltration and inflow into the sanitary sewer system. Only a few public inflow sources were discovered, and they were eliminated. Several miles of sanitary sewers were lined and the most significant leaky pipe joints and manholes were sealed. MSD created an incentive program to fund up to $3,000 for each property to redirect infiltration/inflow sources away from the sanitary sewer system. Even so, private property participation was less than 50 percent. Most of the sewer flow monitoring conducted in the EBMCI service area began in 2001, after public and private Inflow/Infiltration (I/I) sources were disconnected and/or redirected to separate storm sewers. The overall effectiveness of the previous RDI/I program is unknown, but it is clear that peak wet weather flows remain very high and that the problem continues to be widespread in the EBMCI tributary area. It is also clear that RDI/I removal is very difficult and by itself is unlikely to alleviate peak wet weather flows to the point where sustainable measures, such as source control and green infrastructure, or “gray” measures, such as relief conveyance, storage, and treatment, will not be required.

3.4 SSO 700 WATERSHED CHARACTERISTICS

The revised FRP has benefited from multiple iterations of watershed analyses, which are summarized below.

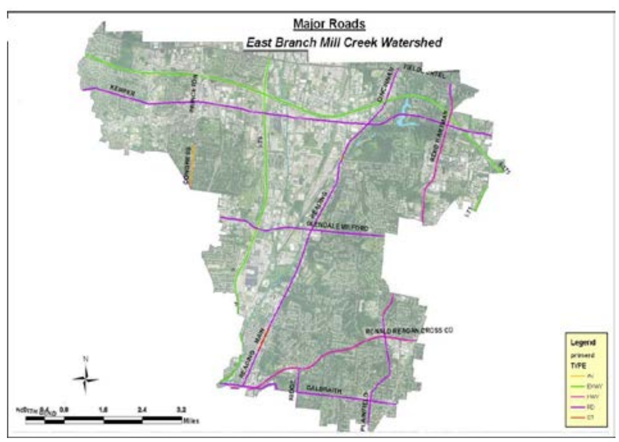
The watershed includes the following cities and townships (West to East): Forest Park, Springdale, Glendale, Sharonville, Sycamore Township, Blue Ash, Evendale, Woodlawn, Lincoln Heights, Reading, Lockland, Arlington Heights, Amberly Village, Montgomery, Deer Park, and Silverton.



Jurisdictions within SSO 700 watershed

There are 3 main interstates passing through this watershed. I-275 crosses the Northern part, I-75 in the west and I-71 touches the eastern border. There are main arterial roads such as, Reading and Reed Hartman that run north to south and are in the eastern part of the watershed. Kemper, Glendale-Milford, Galbraith, and Ronald Reagan Cross County Highway run east to west and they are respectively in the northern, middle, and southern part of the watershed.

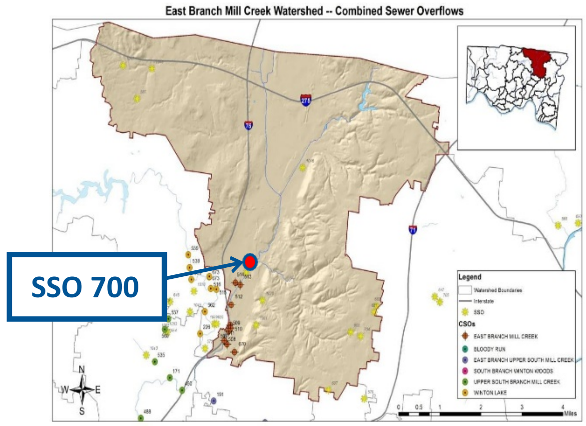
The topography of the watershed is divided into 3 main areas. The eastern part is hilly and steep, the middle section is flat, and the western part is a plateau. There are multiple land uses in this watershed, residential, commercial, industrial, open space, and institutional. There are many parks and recreation areas in the watershed.



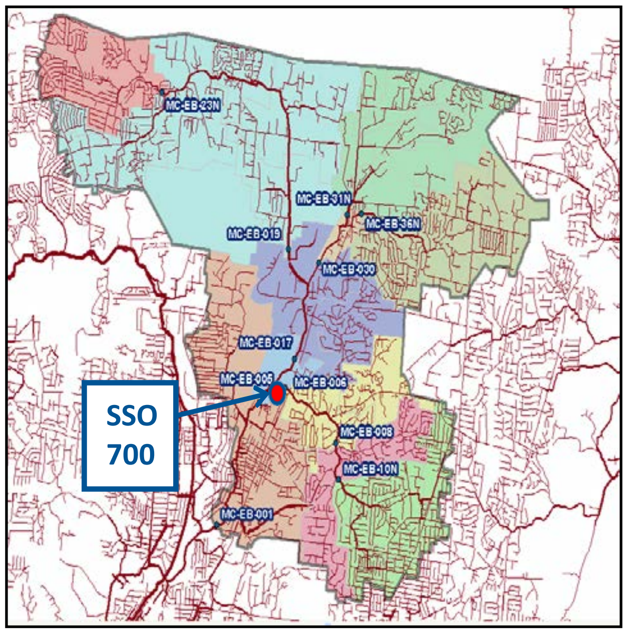
Major Roads and Aerial View of East Branch Mill Creek Watershed

The Mill Creek flows in the middle part of the watershed, where the industrial and commercial land uses are located. The Mill Creek is an important feature in this watershed. There are many activities such as kayaking, walking trails, and nature lovers that take place on and around the creek. There are big industrial parks in the watershed such as General Electric (GE), Ford Motor Company, Pennsylvania Lines LLC, and Formica Corporation.

The watershed has 2 types of sanitary systems, combined and separate. There are 9 CSOs (507, 508, 509, 510, 511, 512, 513, 514, and 670), and 12 SSOs (587, 603, 607, 681, 682, 700, 704, 1001, 10201046, 1047, and 1048). The combined systems are concentrated in the southern part of the watershed and the SSOs are distributed throughout the watershed.



CSOs and SSOs in East Branch Mill Creek Watershed



East Branch Mill Creek Sewersheds and the location of SSO 700

4 Interim and Subsequent Measures to Address SSO 700

4.1 OVERVIEW OF SSO 700 IMPROVEMENTS

Sanitary Sewer Overflow 700 (SSO 700) outfall is located on the 42-inch East Branch Mill Creek Interceptor (EBMCI) sewer which runs parallel to the East Branch of the Mill Creek. The SSO 700 Storage and Treatment Facility (SSO 700 STF) is located in Reading, Ohio on the east bank of Mill Creek, and is approximately 14 miles north of the confluence of Mill Creek with the Ohio River. It handles excess flow from the 42-inch diameter interceptor sewer which receives flow from the nominally separated sewer system that serves the suburban communities of Blue Ash, Evendale, Reading, Sharonville, and Springdale before it reaches the SSO 700 outfall. The initial improvements at this location (CEHRS and storage facilities) were built to reduce the amount of contaminant loading as a demonstration pursuant to the IPCD. A two-year effectiveness study demonstrated achievement of that goal and recommended additional measures to further improve the facility's performance. Subsequently, the recommended additional storage, disinfection, and both mechanical and electrical reliability improvements were made to the facility during the Bridge Phase, which comprise the first component of the final remedial measures to address SSO 700.

4.2 INTERIM MEASURES (COMPLETED PRIOR TO 2012)

At the time the original FRP was submitted in 2012, the major components of SSO 700 STF included a flow interceptor structure and pumping station, storage tanks, screening, a chemically enhanced high rate sedimentation (CEHRS) treatment facility using the proprietary Actiflo® process, and an ultra-violet (UV) light disinfection system. Major components of the SSO 700 STF are sized to eliminate flow bypass during a 2-year SCS Type II design storm; refer to Section 2.1.1. A summary of designed unit capacity is presented in Table 4-1. Some of the units have been replaced by the bridge project (Plan Component No. 1 which is further outlined in Section 7).

Table 4-1. Design Flows for SSO 700 STF

UNIT	PEAK FLOW / CAPACITY
Flow Interceptor Chamber	30 MGD
Pump Station	30 MGD
Intercepted Flow Storage Tanks	3.6 MG
Fine Screening	30 MGD
CEHRS	15 MGD
Disinfection	15 MGD

Interceptor Structure and Influent Pumping Station

The interceptor structure and influent pumping station were constructed around and adjacent to the existing 42-inch influent sewer to intercept and control excess flows into the SSO 700 STF. The 42-inch sewer enters the interceptor structure and flows across an 11-foot long stone pit where heavy objects and solids are deposited, requiring periodic removal using a portable clamshell or vactor truck. Flow then continues through a 3.5-foot square opening where it enters a 23-foot long chamber that is 7.25 feet wide. The chamber has a 23-foot long side overflow weir with a top elevation of 542.00 feet. The

42-inch sewer must be surcharged approximately eight inches for flow to reach the overflow weir crest. A 3.5-foot square sluice gate at the diversion chamber outlet can be closed to force flow over the overflow weir. A 3-foot square opening with an inlet elevation set 8- feet 4-inches above the diversion chamber floor allows flow to be released downstream to the EMBCI when the 3.5-foot square sluice gate is closed.

Overflows occur at SSO 700, located several hundred feet downstream of the interceptor structure, due to a combined sewer backwater condition in the EBMCI. During high flow conditions, the EBMCI surcharges due to limited discharge capacity and causes backwater conditions. Under the original design of the SSO 700 STF, if surcharging occurred, or when the downstream water elevation became 8-feet in depth, the interceptor chamber sluice gate automatically closed and all upstream flow collected in the sewer upstream of SSO 700 STF was diverted into the STF until downstream sewer capacity became available. In order to correct the downstream surcharging condition, a flap gate was installed in 2008 at the 3-foot square opening to prevent backflow from the EBMCI when the sewer becomes surcharged. This operational mode was not outlined in the SSO 700 STF Operation & Maintenance Manual (BBS, 2007), and has since been adopted by the Metropolitan Sewer District of Greater Cincinnati (MSDGC) to counter-act downstream surcharging.

Above the interceptor chamber sluice gate, a second opening, 4-feet wide by 3-feet high and with an invert elevation of 545.50 feet, is located to relieve flows beyond the SSO 700 STF capacity to the downstream EBMCI. This opening limits the maximum water surface elevation that can occur in the influent pumping station wetwell when the chamber sluice gate is closed.

Excess flow overtopping the overflow weir falls into a chamber with a bottom elevation of 534.50 feet. Flow exits this chamber over a 3-foot high weir wall that is 10 feet long. This chamber contains a small submersible pump for influent sampling. Flow passing over the 3-foot high weir then passes through one or two 3-foot square openings with sluice gates and drops into a pump inlet flow distribution channel. The pump inlet flow distribution channel is 21.5-feet long, 2.5-feet wide, by 10.5-feet deep, and has a bottom elevation of 528.00 feet, four feet above the wetwell floor. Two 4- foot long openings at either end of the channel floor are centered on the suction openings of two pairs of submersible influent pumps.

A rotary brush screen was originally mounted on top of the 23-foot long overflow weir, and was intended to act as a screen to protect the influent pumps and downstream process equipment. The rotary brush screen did not function well and was removed in 2008. A screen facility, employing perforated plate screens, was installed in 2009 to protect the CEHRS and UV systems; refer to Section 1.1.3.

Within the influent pumping station wetwell, two pairs of identically-sized non-clog submersible wastewater pumps are spaced at 8.5-foot center-to-center. There is 9-foot spacing between the two middle pumps. The wetwell is 47-feet long by 31.25-feet wide, providing a volume of approximately 11,000 gallons per foot of depth. The pumps are EBARA Model 400DSC3, each rated for a flow of 7,000 gallons per minute (gpm) or 10 mgd at 63 feet of head. Pump No. 1 is equipped with a 150 horsepower (hp) variable speed drive. The other three pumps are equipped with 150 hp constant- speed drives. One of the constant-speed pumps serves as a standby unit. The influent pumps discharge into a common header that connects to a 36-inch diameter force main. The force main branches into two discharge pipelines at a tee inside of the storage tank influent vault, and isolation valves in each pipeline permit discharge to Storage Tank No. 1 (ST-1), Storage Tank No. 2 (ST-2), or both at the same time. There are no flow meters between the influent pumping station and the two storage tanks.

Storage Tanks

The three existing storage tanks at SSO 700 STF each have an inside diameter of 87-feet with an average sidewall depth of approximately 27 feet (corresponding to a water level elevation of approximately 586.00 feet). This corresponds to a storage volume of 1.2 MG for each tank and a combined total storage of 3.6 MG.

During the first year of operation of the SSO 700 STF, it was observed that the reinforced concrete ringwall foundations had cracked and that seepage from surface cracks occurred when the tanks became full. To correct this issue, steel bands were installed around each tank ringwall to provide additional reinforcement. This work was completed in January 2011.

Treatment Facilities

The treatment facilities consist of fine screens, chemically enhanced high-rate settling (CEHRS) and UV disinfection. Flow from the storage tanks is directed to the treatment facilities through a 30-inch pipeline and is controlled by using a flow meter and throttling valve within the CEHRS influent vault. The 30-inch CEHRS influent pipeline may be fed from either ST-1 or ST-2 by use of isolation valves within the CEHRS influent vault. The current operation method is to use ST-1 as a “first flush” containment and settling tank, and to direct flow to the treatment facilities from ST-2. A treatment process schematic for the existing SSO 700 STF is shown on Figure 4-1.

As further indicated on Figure 4-1, flow from the storage tanks is directed to one of two mechanically cleaned perforated plate screens placed immediately upstream of the CEHRS process. The fine screens were installed in 2009 to prevent clogging of the sludge/sand recirculation hydrocyclones and the UV disinfection baffle plate. The screens have 6 mm circular opening, are manufactured by Headworks USA, and are each rated for 15 MGD.

The CEHRS process uses four stages to achieve coagulation, ballasted flocculation, and settling of solids. Flow enters an initial mixing chamber where polyaluminum chloride (PACl) is added and mixed using a submerged injection type mixer. Flow then moves over a submerged baffle wall to a second chamber equipped with a rapid mixer where polymer and microsand are added. Flow passes beneath a baffle wall to a slow-mix flocculation tank. Then flow passes over a final baffle wall into a settling tank with lamella plates. The sludge and microsand mixture that settles in the settling tank is pumped to hydrocyclones mounted above the rapid mix chamber to separate the microsand from the settled wastewater solids. The microsand is returned by gravity to the rapid mix chamber and the separated solids are returned to either the 42-inch interceptor sewer downstream of the diversion chamber or to the influent pumping station wetwell by positioning of sludge valves located in the CEHRS sludge vault.

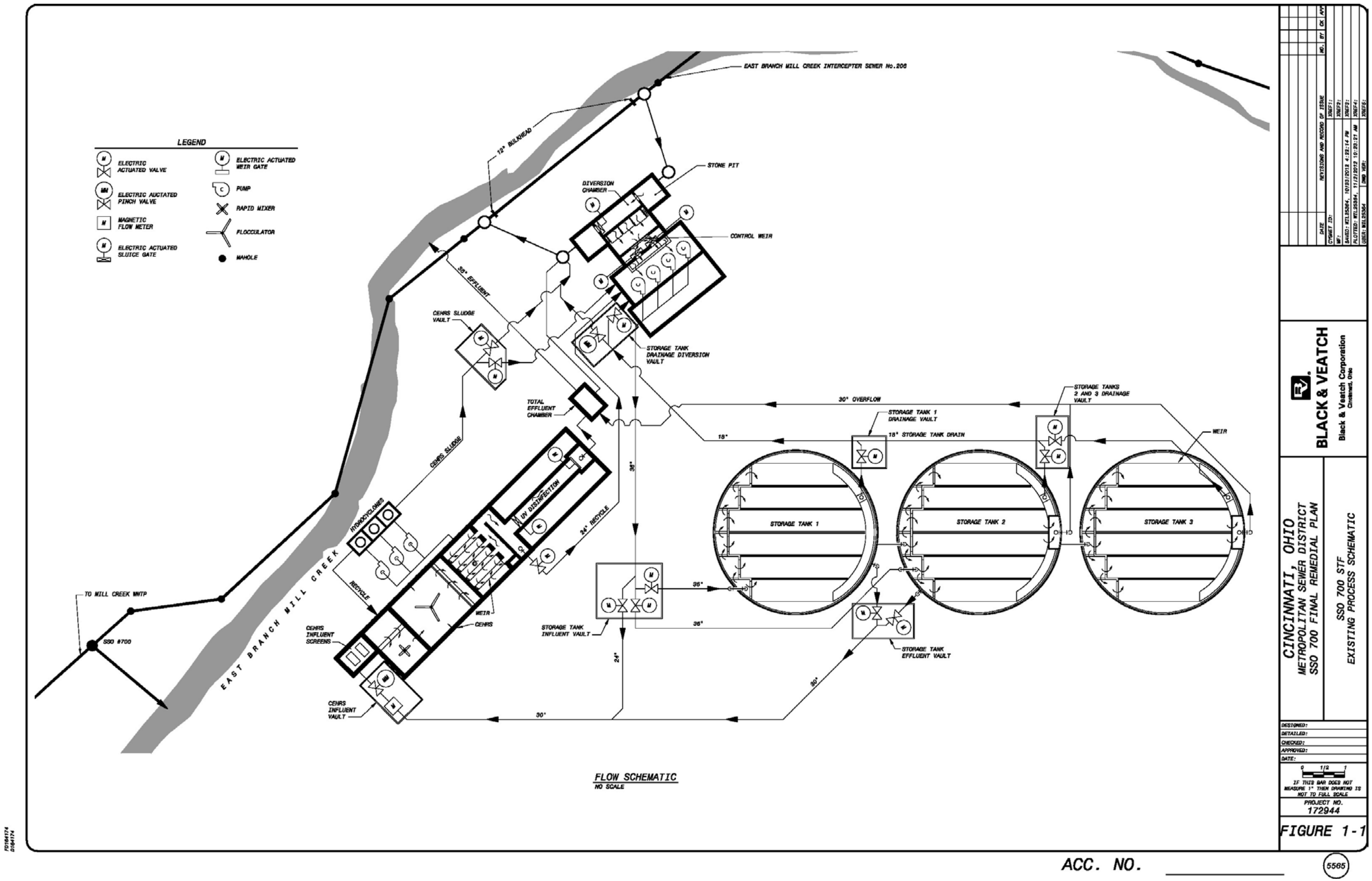


Figure 4-1. SSO 700 STF Existing Process Schematic

Support Systems

Major support systems and facilities include the treatment building with its chemical feed and storage systems; the HVAC and plumbing systems; the valve vaults and junction chambers; the storm drainage system; the electrical power and distribution system; and the instrumentation and control system.

Intended Operations

The original SSO 700 STF Design Memorandum (BBS, 2004) described four operating strategies to control the SSO 700 STF storage and treatment processes. The details of these operating strategies were refined and adjusted in the SSO 700 STF Operation & Maintenance Manual (BBS, 2007). A brief description of the intended role for each operating strategy is presented below. Refer to the SSO 700 STF Operations & Maintenance Manual (BBS, 2007) for a complete description of the operating strategies.

- Operating Strategy No. 1 (OS-1) – This was the intended strategy for small to-medium sized rainfall events. Treatment is not initiated until storage capacity is nearly used up.

- Operating Strategy No. 2 (OS-2) – This was the intended strategy for large rainfall events. The objective of OS-2 was to optimize the treatment of diverted flow. Treatment is initiated at 3 mgd after ST-1 is approximately half full. Treatment rate is gradually increased up to 15 mgd as necessary, while flows above 15 mgd are directed to ST-1.

- Operating Strategy No. 3 (OS-3) – This was the intended strategy for very large, long-term rainfall events with the objective to maximize the treatment of diverted flow as early in an event at possible. Treatment is initiated at 3 mgd flow when ST-1 is half full. Treatment rate is gradually increased up to 15 mgd as necessary, while flows above 15 mgd are directed to ST-1 and ST-2.

- Operating Strategy No. 4 (OS-4) – This was intended to be a mode for training, demonstration and/or system maintenance (i.e. exercising of equipment).

The SSO 700 STF Two-year Effectiveness Study (2YES) (Burgess & Niple, 2009) recommended that the intended operation strategies be consolidated to provide ease of operation at the normally unstaffed SSO 700 STF.

Initial Control Objectives

The service area upstream of SSO 700 is comprised of approximately 27 square miles of the 166 square mile Mill Creek Wastewater Treatment Plant (WWTP) service area. The area is primarily served by a separate sanitary sewer system that experiences a high degree of Rainfall Derived Inflow/Infiltration (RDI/I). Dry weather flows in conjunction with RDI/I exceed the capacity of the East Branch Mill Creek Interceptor (EBMCI) resulting in overflow at SSO 700.

SSO 700 outfall discharges into Mill Creek at River Mile 13.68. Table 4-2 presents a brief summary of SSO 700 activity estimated in 2004 for use in the 2004 SSO 700 STF Detailed Design Memorandum (BBS, 2004). These estimates were created through utilization of the System Wide Model (SWM) hydraulic model for the 1970 “typical” year rainfall.

Table 4-2. SSO 700 Statistics for the 1970 Typical Year[1]

OVERFLOW VOLUME (MG)	No. OF OVERFLOW EVENTS	DURATION OF OVERFLOW (HOURS)	
51.2	47	890	
ANNUAL POLLUTANT LOADINGS			
OVERFLOW VOLUME (MG)	**TOTAL SUSPENDED SOLIDS (TSS) (lbs/year)**	**5 DAY BIOCHEMICAL OXYGEN DEMAND (cBOD5) (lbs/year)**	**TOTAL PHOSPHOROUS (TP) (lbs/year)**
51.2	73,950	40,080	253
Notes: [1] Statistics taken from the 2004 SSO 700 STF Detailed Design Memorandum (BBS, 2004)			

Volumetric Control Criteria

A goal for SSO 700 STF is to be able to prevent SSO 700 sanitary sewage overflows for events less than and/or equal to the 2-year design storm. The design storm rainfall depths used for this FRP are consistent with values published in the Rainfall Frequency Atlas of the Midwest (Huff and Angel, 1992), and the rainfall distribution used was the SCS Type II storm distribution. The modeling work performed for the SSO 700 STF FRP also consisted of utilization of both the 2-year and 10-year SCS Type II design storms. This is consistent with the design storms to be used to design Capacity Assurance Program Plan ("CAPP") projects per the Final WWIP Attachments 1B and 2, Footnote 4.

Figure 4-2 shows the cumulative rainfall depth for both the 2-yr and 10-yr design storms used for the modeling evaluation. These design storms were applied to the basin uniformly and without any areal reduction.

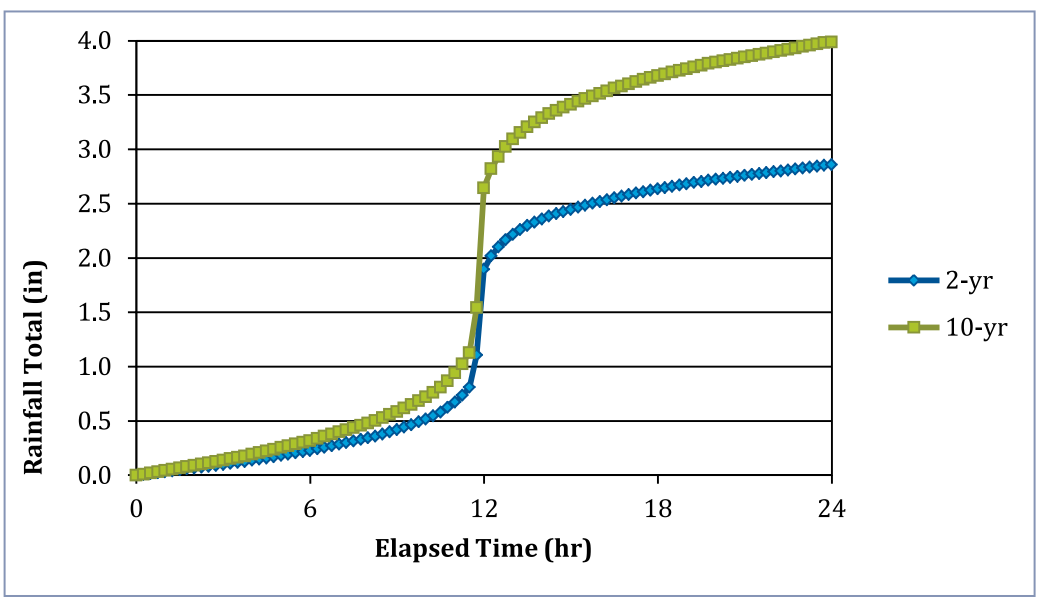


Figure 4-2. Cumulative rainfall depth for 2-yr and 10-yr design storms

Effluent Quality Goals & Tested Performance

Effluent quality standards were not outlined by the 2002 SSO Interim Partial Consent Decree for the SSO 700 STF, but required a demonstration of a CEHRS and storage facility with disinfection. The SSO 700 STF Detailed Design Memorandum outlined a goal:

> *"The facility size, configuration and operation was to be assessed using sound engineering practices consistent with industry standards, recognizing costs and performance to arrive atan optimal design concept for the facility"* (BBS, 2004)

Effluent quality goals and objectives were established in the SSO 700 STF Detailed Design Memorandum (BBS, 2004) based on then-current information for best available CEHRS and UV disinfection technologies. As acknowledged in this Memorandum, the CEHRS system at SSO 700 STF was projected to be operational primarily during wet weather periods when the raw wastewater strength was significantly more dilute that during dry weather conditions. A summary of the variation in wastewater strength seen during these conditions, as presented in the SSO 700 STF Detailed Design Memorandum (BBS, 2004), and which was based on limited sampling conducted upstream of the proposed STF site during wet weather conditions, is presented in Table 4-3. Water quality measurements presented in Table 4-3 were to serve as estimates for the approximate water quality characteristics of SSO 700 STF influent flows.

Table 4-3. Variation in Wastewater Quality EBMCI Upstream of SSO 700 STF[1]

PARAMETER	No. OF SAMPLES COLLECTED	MAXIMUM	MINIMUM	AVERAGE
Total Suspended Solids (mg/L)	4	62	48	54
$cBOD_5$ (total, mg/L)	4	95	46	68
Total Kjehldahl Nitrogen (TKN) (mg/L)	4	13.8	10.7	12.3
Ammonia Nitrogen (mg/L)	4	2.8	2.7	2.7
Total Nitrate/Nitrite (mg/L)	4	1.6	0.7	1.1
Total Phosphorous (mg/L)	4	2.0	1.6	1.8

Notes:
[1]Information taken from the SSO 700 STF Detailed Design Memorandum (BBS, 2004)

Removal efficiencies from existing CEHRS facilities were to be utilized for establishing effluent quality goals for the SSO 700 STF.

Testing between December 2007 and August 2009, described in detail in the SSO 700 STF 2YES (Burgess & Niple, 2009), was used to compare actual tested CEHRS effluent quality to the expected CEHRS performance. Results from this testing are summarized in Table 4-4.

Table 4-4. Projected and Tested Effluent Quality of CEHRS at SSO 700 STF

PARAMETER	PROJECTED CEHRS EFFLUENT QUALITY RANGE[1]	TESTED EFFLUENTQUALITY RANGE[2]

TSS (mg/l)	6-24 mg/l	5-16 mg/l
$cBOD_5$ (mg/l)	18-57 mg/l	13-125 mg/l
TP (mg/l)	< 1 mg/l	0.14-0.387 mg/l
Total Kjehldahl Nitrogen (mg/l)	9-15 mg/l	5.43 to 22.5 mg/l

Notes:
[1]Projected effluent quality is based on limited sampling of raw wastewater quality during wet weather and excursion safety factors.
[2]Tested effluent removal ranges reported from Wet Weather Test #2, #5, and #6 (WWT#2, WWT #5, WWT #6) as indicated within the 2YES (Burgess & Niple, 2009). These tests were utilized as they were considered representative of normal anticipated wet weather events at SSO 700 STF.

In addition to effluent water quality objectives identified for CEHRS effluent flow, lab scale investigations were conducted as part of the SSO 700 STF Detailed Design Memorandum (BBS, 2004). These lab scale investigations were to evaluate the impact on the disinfection process of adding chemicals associated with the US Filter/Kruger Actiflo® process. This analysis was detailed in the SSO 700 STF Detailed Design Memorandum as follows:

- Chemicals were added to four SSO 700 grab samples to simulate effectiveness of UVdisinfection while operation of the Actiflo® process. Chemicals added included: Polyaluminum chloride, anionic polymer, and microsand.
- The impact of UV light transmittance (measured at a wavelength of 254 nanometers) was determined 10 minutes after the chemicals were mixed into the samples and allowed to settle (BBS, 2004).

As specified with the 2004 Detailed Design Memorandum, the results of four samples showed that UV transmittance varied within a range of 43-51% before the chemicals were applied and within a range of 66-79% after chemical dosage and settling occurred. This outcome, as indicated within the 2004 Detailed Design Memorandum, provided assurance that the addition of these chemicals would not interfere with the disinfection process (BBS, 2004).

Testing between December 2007 and August 2009, described in detail in the SSO 700 STF 2YES (Burgess & Niple, 2009), was used to determine effectiveness of the SSO 700 STF CEHRS and disinfection facilities. Wet weather testing events utilized to simulate normal anticipated events at the SSO 700 STF found that the STF was capable of producing an effluent quality equal to or better than that anticipated pre-design. Specifically, the 2YES indicated that:

> *"On an annual basis 88.5% of total suspended solids, 60.8% of biochemical oxygen demand,and 92 to 98% of bacteria which entered the system were removed and not released to the stream"* (Burgess & Niple, 2009)

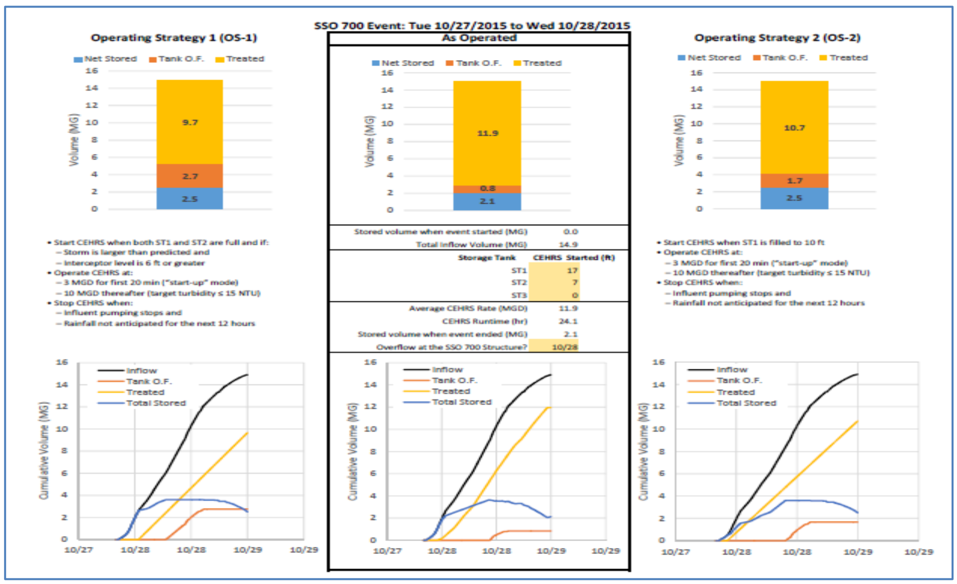
It was noted in the 2YES that though testing was performed for normal anticipated events at the SSO 700 STF, there were a number of facility improvements, both physical and operational, that can improve reliability, effectiveness, and safety at the SSO 700 STF.

4.3 SUBSEQUENT IMPROVEMENTS (COMPLETED AFTER 2012)

In 2013 MSD initiated a watershed-based approach to its operations with the intent to maximize conveyance and treatment capacity of the wastewater system during wet weather. MSD operations focused attention on the operating wet weather assets with the ultimate objective of optimizing their performance at a localized area as well as in the context of a watershed, in coordination with other MSD assets. The SSO 700 Wet Weather Storage and Treatment Facility (STF) was identified as an important MSD asset that could provide enhanced control of wet weather overflows in the Mill Creek basin. Initially designed to reduce overflows from SSO 700, this facility is now part of an operational strategy that broadens its use for basin wide overflow reduction.

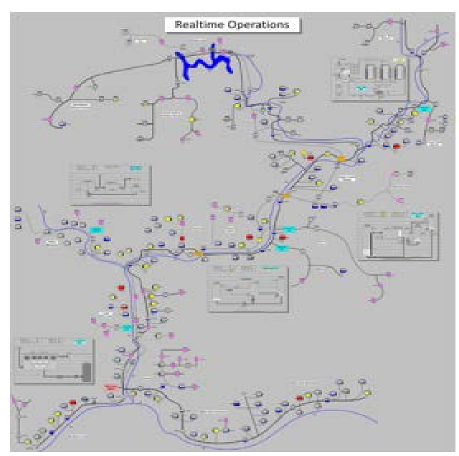
2013 - Facility Readiness

Beginning in 2013, several improvements were made to increase the readiness of the SSO 700 STF to operate as designed. Several key work activities began at this time.



Simulated SSO 700 STF performance with two ideal operating strategies as compared to the actual performance

<u>O&M</u> - New maintenance strategies were developed for the facility, applying reliability centered maintenance (RCM) best-practices. Bi-weekly SSO 700 STF meetings were also established and include maintenance, operations, and SCADA personnel. These meetings are structured to ensure that corrective maintenance needs are kept at the forefront and addressed in a timely manner, to review the facility performance for any prior wet weather events, and discuss lessons learned. New event-based facility performance reports were developed for analysis and discussion with staff and operators every two weeks. They include total storage, treatment, and tank overflow volumes based on the manner in which the facility was operated, and compares it to the estimated volumes for the targeted operating strategies for small and large rain events. Also included in these reports are the corresponding activation of the downstream SSO 700 constructed overflow, to understand facility's effectiveness at overflow reduction or avoidance.



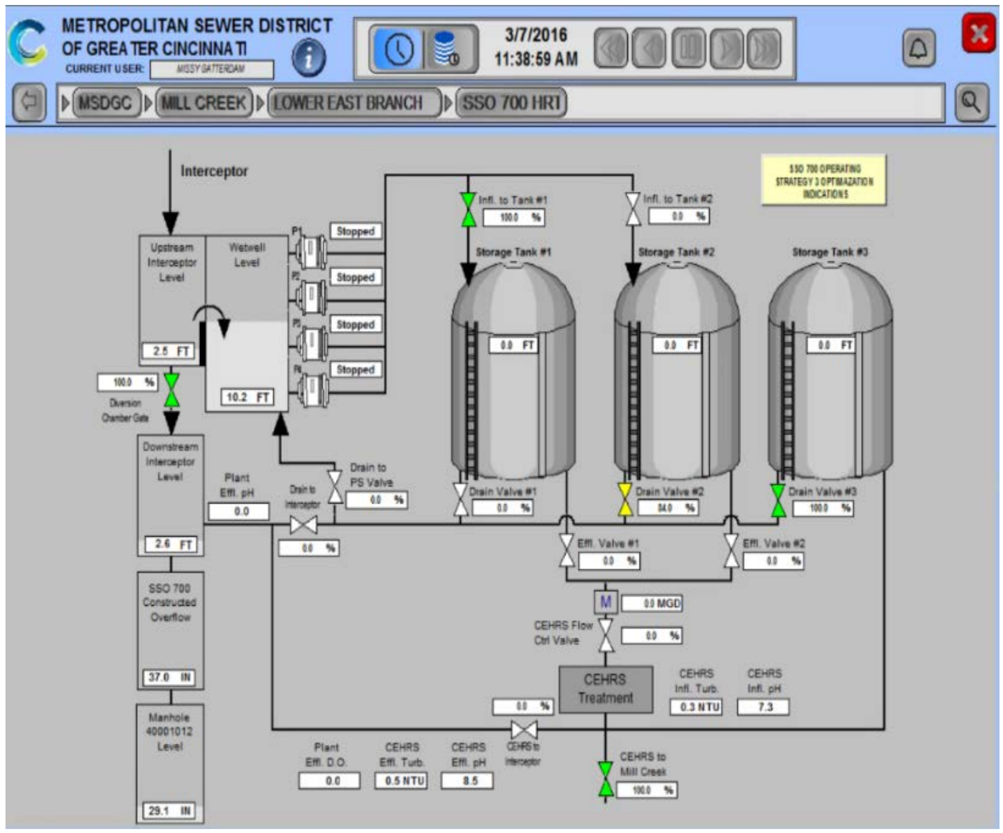
MSD's Wet Weather SCADA System

<u>Advancement of Reliability Improvements</u> - Persistent failures of the instrumentation and controls (I&C) system led to the advancement of upgrades to the Fieldbus and DeviceNet networks which manage communications between sensors, equipment, and the control systems, and used in the operation and monitoring of the plant's storage and treatment processes. These improvements were outlined in the original 2012 SSO 700 Final Remedial Plan, the industrial control network failures were deemed critical to the reliability of the facility and MSD expedited the I&C controls project to ensure reliable operation of the facility.

2014 - 2016 - Facility Operational Optimization

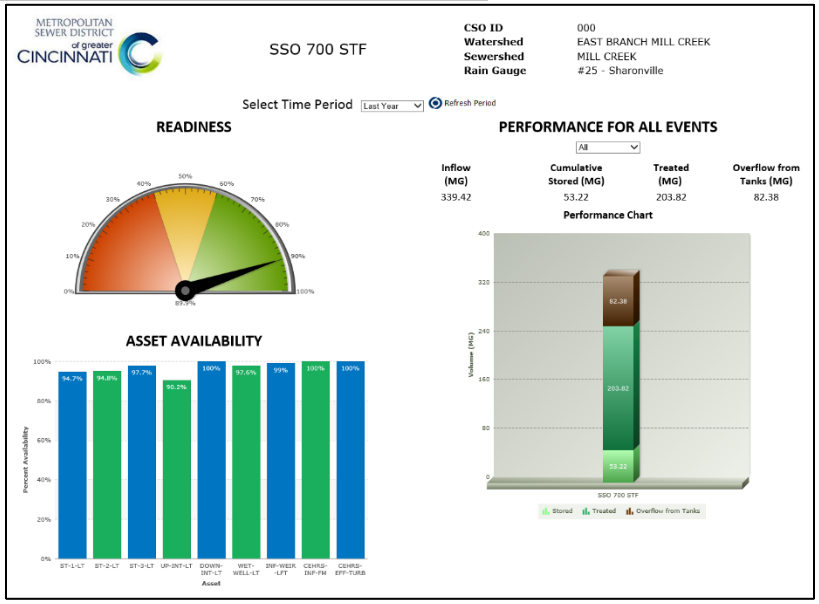
The advancement of remote sensor technology and reliable low-cost cellular communications has made real-time data networks a reality for sewer systems, paving the way for 'smart sewer systems.' In early 2015 MSD's Wet Weather SCADA system was launched which now provides the backbone to achieving operational optimization of the collection system during wet weather. Within the Mill Creek basin this tool captures field data from remote sensors and wet weather facilities and visualizes real-time conditions along the interceptors from the Mill Creek treatment plant to the SSO 700 STF. Its use is being expanded to provide coordinated control of wet weather assets to further optimize their use for overflow reduction in other parts of the system and to maximize available collection system capacity.

<u>Local Optimization</u> – A revised operating strategy was implemented in August of 2014 for rain events anticipated to produce more flow than what could be stored (OS-2). This operating mode anticipates the need for treatment of larger forecasted storm events. Treatment is initiated once the first tank reaches 10' in storage depth, thereby reserving as much storage in the tanks as much as possible throughout the event. MSD evaluated staffing options for SSO 700 STF to address staff mobilization from the Mill Creek WWTP which is important to facilitate basin-wide control strategies to maximize conveyance and treatment.



SSO 700 STF screen in Wet Weather SCADA System enables remote monitoring

The Wet Weather SCADA System enables remote monitoring of the SSO 700 STF operations and surrounding conditions from anywhere on mobile devices, which provides an earlier indication of problems and better coordination of resources.



SSO 700 STF dashboard

<u>Automating Basin Level Optimization</u>

Through a detailed analysis conducted in 2015, it was determined that there are two critical operational events, the timing of which are crucial to the facility's performance during wet weather. The first event is the time when flow is diverted into the facility's storage tanks, and the second when the high-rate treatment process is started.

The facility was designed so that these events were initially driven by static set points. Flow into the facility was driven by the height of the diversion chamber's influent weir and the starting of the high-rate treatment process was driven by specific levels of water in the facility's storage tanks, depending on what size storm was *anticipated*. These met the original design criteria but did not allow for the dynamic nature of rainfall and its spatially varied distribution during a real rain event. While flow was diverted from the interceptor and notable volumes of wet weather flow were treated, there were still opportunities to catch and treat more flow and exceed its design criteria and do it in a more economical fashion. Specifically, the analysis illustrated that management of these events was optimal if based on the conditions in the interceptor as they occurred in real-time, rather than static set points and weather predictions.

Following the operational and performance analysis done in early 2015, a new set of operational rules were developed to improve the timing of the two critical events. First, it was determined that flow past the facility should be limited to the carrying capacity of the downstream interceptor. This was accomplished by modulating the gate on the interceptor just below the facility's diversion chamber. Existing level sensors were leveraged and hydraulic calculations were applied to adjust the position of the gate to force more flow into the facility when conditions in the interceptor warranted. Second, the new wet weather SCADA system was leveraged to monitor a level sensor several miles downstream of the facility, in the proximity of where the hydraulic bottleneck forms during significant rain events. When the hydraulic bottleneck forms, treatment is initiated to enable the facility to take more flow and further offload the system.

In 2016, three important optimizations were performed to enhance SSO 700 STF's impact beyond its original design. These improvements were aimed at improving the ability reducing what is currently the biggest hurdle to improved operations, which is receiving sufficient and reliable warning that the facility will need to be put into operation.

1. New sensors were placed downstream of the STF. Sites were identified through analysis of flow data at key points in the system. These sensors detect with greater accuracy the development of hydraulic constrictions downstream that are indicative of the system being overloaded and hence require the use of the high-rate treatment process.

2. New sensors were placed upstream of STF. These sensors monitor the increasing flows from tributary sewers from which projections of the future flow passing the STF can be derived

(this approach is also used at Mill Creek WWTP). This allows MSD to adjust the timing and volume of flow diverted into the facility in a more proactive manner to eliminate the potential for an overflow at SSO 700 as well as to avoid overloading the downstream system. Both sets of sensors relay critical information through the Wet Weather SCADA system.

3. Additional logic and control algorithms were developed to enable the SSO 700 STF to store and treat flow optimally based on conditions, both present and future, across the entire Mill Creek basin. These control algorithms are based on hydraulic conditions in real time and further optimize the use of the facility in a proactive, yet economical, manner.

2017 - 2020 – Capital Improvements

As a result of the ongoing studies and signification discussions among the Regulators and Defendants, additional capital improvements were identified. As a result, MSD advanced the following three SSO 700 reliability upgrades (a detailed list can be found in table 7-1), which comprise the first component of the recommended FRP, during the Bridge Phase and are substantially complete:

10241825 SSO 700 Operational Improvements Project
This project took care of the faulty instrumentation issues that kept the facility from functioning reliably. Dealt with instrumentation and controls as well as relocating actuator electronics above ground.

10241820 SSO 700 Facility Improvements Project
This project completed the bulk of the items committed to in the FRP including the additional storage tank, additional Coagulant storage tank, CEHRS Solids pump station, new Polymer system, and A/C upgrades for UV. This effort also provided a separation of the facility outfall so that discharges from CEHRS could be differentiated from storage tank overflows.

10142070 SSO 700 Disinfection Improvements Project
This project provided chemical disinfection for facility overflows from the additional tank that was installed in the previous project.

Storage and treatment operation continued throughout these construction activities with minimal interruption or missed events. Many of the improvements will serve to make the facility more reliable and better prepared for wet weather events. Addition of treatment chemical storage and replacement of obsolete equipment, such as the polymer system and UV, will serve to allow this facility to successfully operate into the future.

2017 Performance Monitoring Results

Most recent effluent quality data predates the Reliability Improvements. However, the sampling data collected in 2017 shows the significant reduction in facility effluent E. Coli and TSS and is summarized below:

SSO 700/CEHRS E.coli and TSS Data Summary for 2017

Date	TSS (mg/l) Plant Inf	TSS (mg/l) CEHRS Inf	TSS (mg/l) CEHRS Eff	E.coli (#/100ml) Plant Inf	E.coli (#/100ml) CEHRS Inf	E.coli (#/100ml) CEHRS Eff	E.coli (#/100ml) UV Eff	Notes
1/20/17		51-67	3-58		>242000	24900-155300	1720-30800	UV issues
2/28/17		64-91	9-26		>242000	198000->242000	370-6130	
3/8/17			4-8			104600->242000	100-810	
3/21/17		56-92	6-12		980400-1299700	185000-307600	31-41	
3/31/17		54-69	11-37		980000-1553000	178000-579000	1000-3870	Consistently high flows and higher turbidity
4/17/17		36-63	8-11		1046200-1299700	125000-235900	200-850	
4/29/17		64-137	9-34		1046200-1732900	114500-228200	1076-2282	
5/1/17		29-70	13-17		1553100-2419600	275500-547500	497-3784	
5/4/17		48-131	5-17		1413600-2419600	488400-1119900	5200-8600	Consistently high flows and higher turbidity
5/9-10/17		42-188	6-140		980400-2419600	108600-816400	860-14390	Coagulant recycle valve stuck open
6/23/17	76-83	61-94	3-11	1413600		727000-920800	3873-4352	Consistently high flows and higher turbidity
7/13/17	120-130	80-84	9-13	>242000		1732900-2419600	>24196	One UV bank out
11/6/17*	35	42-45	6	251000		21600-37300	10	

*Preliminary data presented

Due to the only recently completed construction activities MSD has not yet resumed sampling and analysis of the facility to quantify performance. MSD plans to reinstate performance monitoring sampling and analysis later in 2022 in order to better quantify system performance. It is anticipated that these projects have improved upon previous facility performance.

5 Water Quality Modeling

The information in this section was included in the original 2012 SSO 700 FRP submission in fulfillment of the requirements of the Consent Decree. The analysis work was completed prior to the subsequent operational and capital improvements described in Section 4.3, and therefore refers to the state of the system in 2012 as “current.” “Future,” as used in this section, refers to the state of the system following the operational and capital improvements.

In addition to the required 2YES, discussed in Section 6 below, MSD, with the assistance of LimnoTech, voluntarily created the Mill Creek EFDC water quality model for the Mill Creek during the LMC Study. Details regarding that modeling effort are available in the LMCPR Report. An initial application of the EFDC model in the context of SSO 700 and the SSO 700 STF illustrates the water quality improvement that the facility provides and can continue to provide to the length of Mill Creek from the SSO700 outfall to the Ohio River.

The objectives of this Water Quality Analysis were to evaluate the water quality benefits in Mill Creek from the existing treatment facility and the potential additional benefits from investing in an additional storage and making the facility safer and more reliable. The analysis was conducted for a single storm event (March 4-5, 2011) when the facility was at typical operating conditions by applying the Mill Creek portion of the regional Ohio River EFDC water quality model to simulate bacteria (*E. coli*) levels in the creek.

Flow monitoring and water quality sampling data for SSO 700 outfall led to it being noted as one of the largest and most frequently overflowing discharges, activating during storms as small as 0.10 inches. The amount of bacteria in this SSO averaged approximately 6,200,000 cfu/100 ml, significantly higher than the systemwide SSO bacteria level of approximately 2,000,000 cfu/100 ml (MSDGC 2006).

Figure 5-1 presents a schematic of the demonstration treatment facility and the portion of the collection system in the vicinity of SSO 700. During dry weather, flow in the system is routed to the Mill Creek wastewater treatment plant (WWTP). During rain events, additional wet weather flow enters the collection system. Up to 30 MGD of this wet weather flow can be pumped into the demonstration treatment facility. During small rain events, the wet weather flow is contained in the three storage tanks, and then slowly released back into the system after the storm event for routing and treatment at the Mill Creek WWTP. During larger rain events, some of the volume in the tanks is routed into the CEHRS/UV treatment train and some of the volume in the tanks overflows. The flows from these two parts of the facility are collected into a single pipe and discharged to the creek as final effluent. Finally, during very large rain events or high intensity storms, the wet weather flow exceeds the capacity of the demonstration treatment facility and some flow may be discharged via storage overflow into the stream without going through CEHRS. Figure 5-1 also provides the associated sample locations.

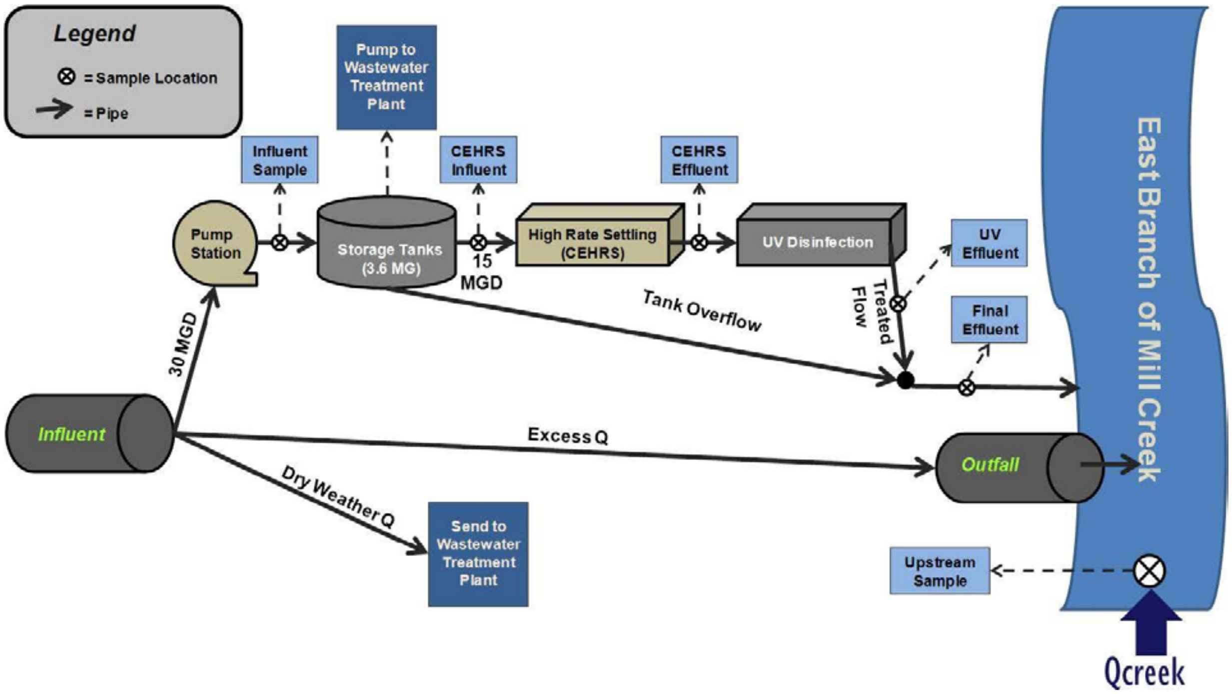


Figure 5-1 Schematic of SSO-700 Demonstration Wet Weather Treatment Facility and SSO-700.

Monitoring over the four years that the demonstration treatment facility had been in operation (June 2007-June 2011) indicates that SSO-700 discharged untreated wastewater through the SSO 700 outfall approximately 8 times per year.

The data sources summarized in Table 5-1 were used to develop flow and E. coli inputs for the water quality model scenarios. Hourly flows for SSO-700 and the treatment facility were specified in the Treatment Facility Data file. Hourly Mill Creek flows were specified using the USGS gage data at Carthage. The Pre-WWIP Monitoring data at SSO-700 and results from a Two-Year Facility Effectiveness Study (2YES) water quality data were used to specify the E. coli inputs for each modeling scenario. The two-year effectiveness study (2YES) of the demonstration treatment facility was conducted between 2007 and 2009.

Table 5-1. Summary of Data Sources Used in SSO-700 Water Quality Analysis.

Data Source	Data Type	Description	SSO-700 WQ Model Scenario
WWIP Volume VI-Water Quality Data Report (MSDGC 2006)	SSO-700 *E. coli*	Includes *E. coli* monitoring data measured at SSO-700 prior to WWIP implementation	Pre-facility construction
SSO-700 2 Year Effectiveness Study (2YES)	Facility *E. coli*	Includes *E. coli* monitoring data at various points in the facility process	Current Facility
(Burgess and Niple 2009)	Upstream Mill Creek *E. coli*	In-stream *E. coli* upstream of SSO-700 Discharges	Future Facility
Treatment Facility Data (FPR development)	Facility Operations Summary	Influent and effluent *E. coli* data from 2007-2012 Rainfall and Facility flow data	Current Facility Future Facility

USGS Flow Gage	Mill Creek Flow	Hourly Upstream Mill Creek flow	All
Treatment Facility Data (facility readiness testing)	Facility Operations Summary	Influent and effluent *E. coli* data from 2017	n/a

Other sources in the Mill Creek watershed, including CSOs, other SSOs, and stormwater were specified using the same methods used to calibrate the Mill Creek EFDC water quality model (LimnoTech, 2012). The collection system model used to simulate these sources was SWMM 4.0, which reflects projects completed through 2010. The same flow and E. coli densities for these sources were used in each model scenario so that the only variation between the scenarios was the configuration of the demonstration treatment facility.

Table 5-2. Water Quality Model *E. coli* Inputs by Scenario as performed for the 2012 submission

*No new water quality models for the FRP. MSD did perform extensive modeling for IWAP which affirmed the FRP is the most beneficial watershed solution to address E.coli.

Input Type	Model Source *E. coli* Input	Water Quality Model Scenario		
		Pre-Facility (Pre-WWIP)	Current Facility	Future Facility
E. coli (cfu/100 ml)	SSO-700	6,220,000	6,220,000[a]	775,000
	Storage Tank Overflow	N/A	775,000	775,000
	CEHRS/UV Effluent	N/A	1,400	1,400
	Mill Creek Upstream	14,000	14,000	14,000

Notes:

[a] While the influent concentration is 775,000 cfu/100 ml, the SSO-700 discharge concentration in this scenario reflects the approximate tenfold increase in bacteria levels resulting from discharging the solids from the CEHRS facility through the SSO outfall. These solids were discharged throughout the duration of the SSO 700 overflow in this scenario.

The EFDC water quality model was determined to be the most appropriate to characterize current and future water quality conditions. The EFDC model was configured to start on March 1, 2011 and run through March 13, 2011, which spans the March 4-5, 2011 storm event and time needed to transport the wet weather loads down the creek. The model was applied for this time period for each scenario. Hourly outputs from each model grid cells were processed to generate the results presented in the next section (Model Results). Each source type was tracked separately within the model using distinct state variables. This convention allowed the total in-stream bacteria levels to be simulated as well as the impacts from the SSO 700 and treatment facility alone on creek water quality.

Model Scenario Input Comparison

The model inputs for each scenario were compared on the basis of SSO 700 overflow and treatmentfacility discharge volume (Figure 5-2), the average *E. coli* density from SSO 700 and the treatment facility on a flow-weighted basis (Figure 5-3), total *E. coli* load from SSO 700 and the treatment facility (Figure 5-4) and the total number of hours of untreated discharge through SSO 700 (Figure 5-5).

Figure 4 illustrates that prior to the treatment facility (pre-WWIP), the entire overflow volume (40MG) was discharged through the SSO 700 outfall. With the current treatment facility, the total volume is the same (40 MG) but most of this volume (~27 MG) is treated effluent from the CEHRS/UV system. Less than 5 MG is untreated SSO 700 overflow volume. With the future facilityconfiguration, the total volume is slightly less, reflecting the addition of one more storage tank, andthe distribution of volume between the CEHRS/UV, tank overflow and SSO-

700 are similar.

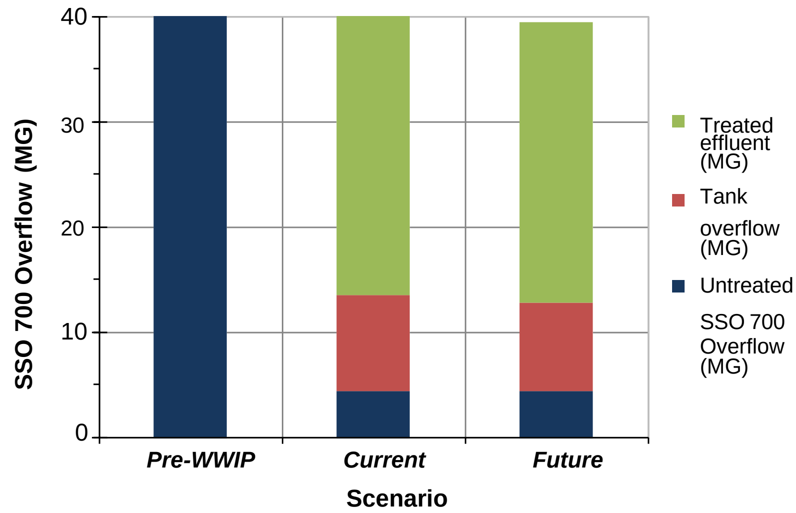


Figure 5-2. Comparison of SSO-700 (and Treatment Facility) Volumes (MG) for Each Model Scenario.

Figure 5-3 shows the flow-weighted average *E. coli* level from the SSO 700 and treatment facility discharges into Mill Creek. In the pre-facility (pre-WWIP) scenario, the average *E. coli* density discharged was 6,220,000 cfu/100 ml, reflecting the SSO 700 sampling data conducted for the WWIP. In the current facility scenario, the volumes shown in Figure 4 were applied to the density inputs listed in Table 5-2 to calculate a flow-weighted density of 867,000 cfu/100 ml, which is nearly an order of magnitude less than the pre-facility scenario level. At a minimum, it is an 85% reduction in the average *E. coli* discharge density. Finally, in the future facility scenario, the average *E. coli* discharge density is smaller yet (253,000 cfu/100 ml), reflecting the improved quality of theSSO-700 discharge resulting using the additional storage tank in this scenario to handle the solids from the CEHRS system rather than discharging them through the SSO 700 outfall.

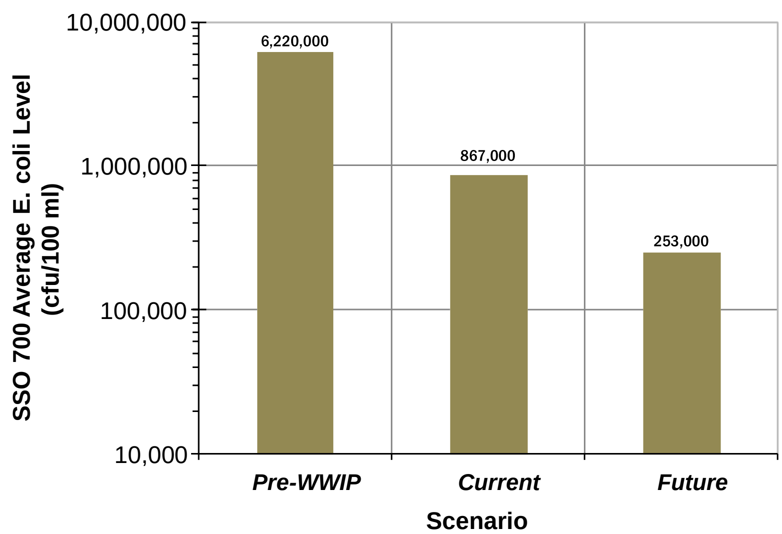


Figure 5-3. Comparison of SSO-700 (and Treatment Facility) Average *E. coli* Level (cfu/100 ml) Discharged to Mill Creek in Each Model Scenario.

As Figure 5-3 illustrates, the improvement in solids handling in the future facility reduces the average *E. coli* level discharged by a factor of three (70% reduction) compared to the current facility. This benefit is further illustrated by comparing the total *E. coli* load from each scenario, as shown in Figure 5-4. The pre-facility scenario (pre-WWIP) has the highest *E. coli* loads (1.0×10^{16} cfu) and because the loads in the current and future facility scenarios are so much smaller than the pre-facility scenario, the results in Figure 6 are expressed as a percentage of the pre-facility scenario. The current facility resulted in an 85% reduction in total load, with most of the load originating in the SSO 700 overflow containing the CEHRS system solids. Adding the extra storage tank and changing the CEHRS solids handling in the future facility scenario results in a 95% reduction in total *E. coli* load relative to the pre-facility scenario.

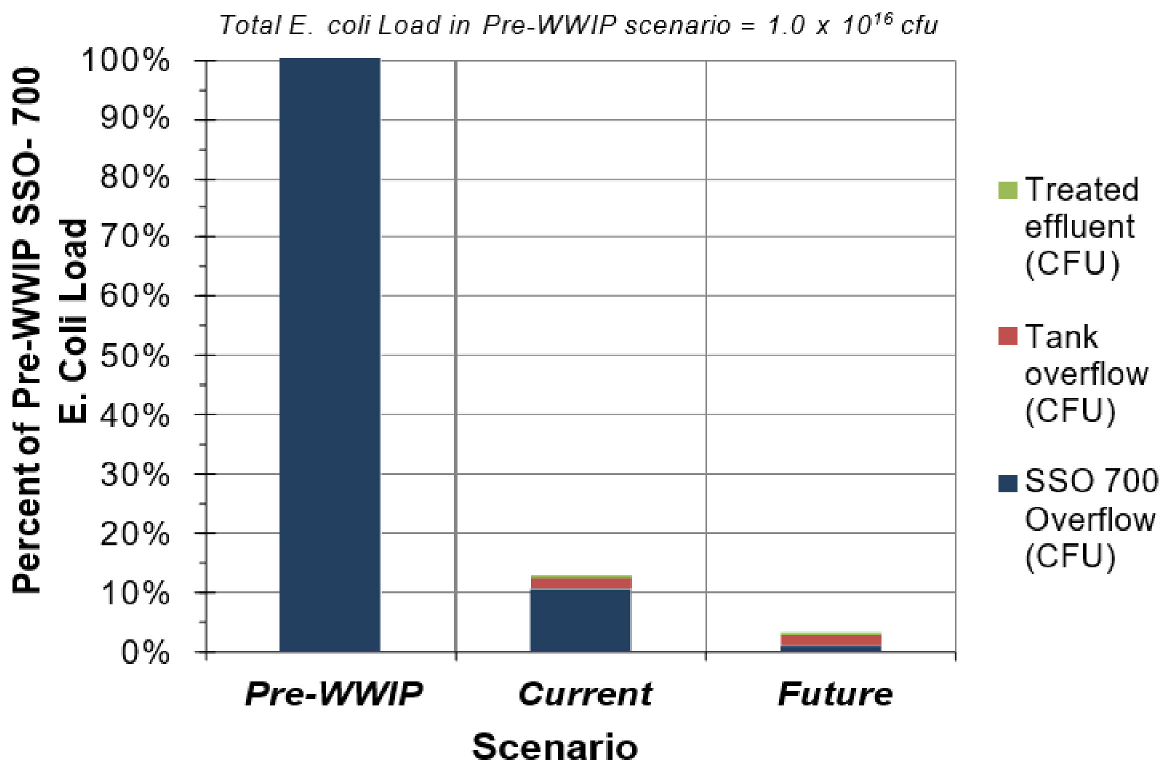


Figure 5-4. Comparison of SSO 700 (and Treatment Facility) *E. coli* Load (cfu) in Each Model Scenario.

A breakdown of the volumes (shown in Figure 5-2) and *E. coli* loads (shown in Figure 5-4) are presented in Table 5-3 for each scenario within the facility and SSO-700 outfall. As this table illustrates, because of the effectiveness of the CEHRS/UV system in reducing *E. coli*, this unit produces the most discharge volume but contributes less than 1% of the *E. coli* load for the two facility scenarios. Further, the tank overflow becomes the predominant source of *E. coli* in the future facility scenario, reflecting both the fact that most of the wet weather volume is routed into the tank and the improved solids handling in this scenario reducing the SSO 700 *E. coli* levels and corresponding load.

Table 5-3. Breakdown of Volume and *E. coli* Load within the Facility and SSO 700 Outfall.

Component	Volume			*E. coli* Load		
	Pre-WWIP	Current	Future	Pre-WWIP	Current	Future
Untreated SSO	100%	11%	11%	100%	80%	35%
Tank OF	--	22%	21%	--	20%	65%
CEHRS/UV Effluent	--	67%	68%	--	<1%	<1%

The last metric used to compare the model scenarios was the hours of overflow from the SSO 700 outfall (Figure 5-5). As this figure illustrates, the duration of untreated discharge from the SSO 700is reduced from ~90 hours prior to facility construction to less than 30 hours with the current and future facility configurations.

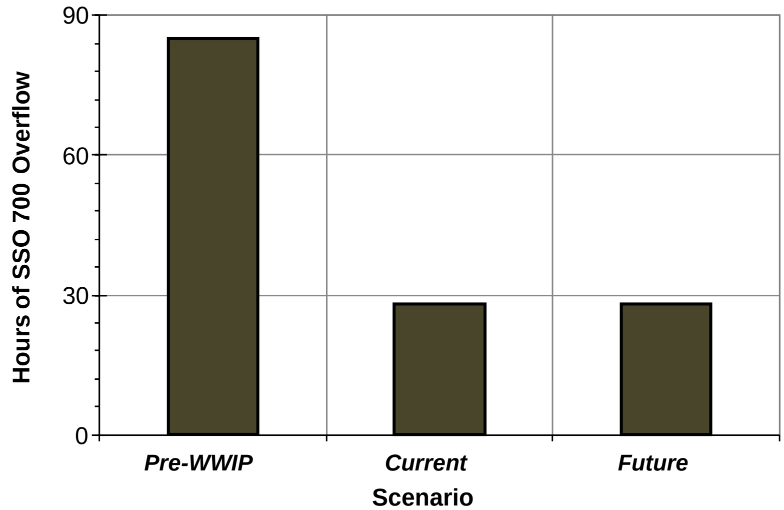


Figure 5-5. Comparison of SSO-700 Duration of Discharge (Hours).

In summary the addition of the storage tanks and CEHRS/UV treatment system has greatly reduced the *E. coli* load into the Mill Creek in the vicinity of SSO 700. It has also reduced the volume and load that overflows from SSO 700. These benefits will improve even further in the future facility configuration.

In-Stream SSO-700 Only Effects (No Background Sources)

Because different bacteria sources were modeled with distinct state variables in the model runs, theeffects of SSO 700 and the treatment facility discharges on Mill Creek water quality can be evaluated. Figure 5-6 shows a comparison of in-stream Mill Creek *E. coli* densities near the SSO 700 discharge location (River Mile (RM) 13.6) for the three scenarios. The “jagged” in-stream *E. coli* levels reflect the variability in the rainfall, the dynamic changes in hourly upstream flows, and the variability in the SSO 700 overflow hourly volumes.

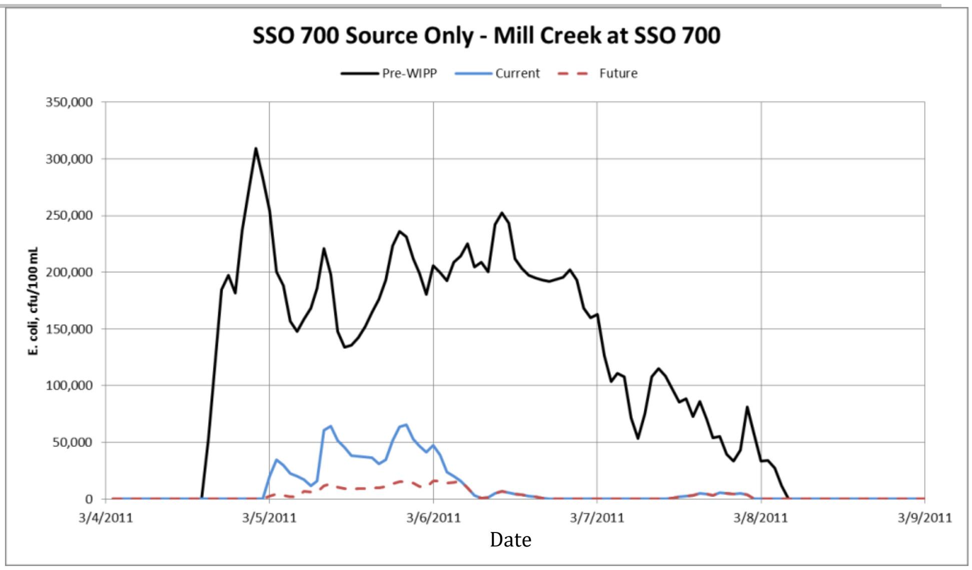


Figure 5-6. In-stream Comparison of SSO 700 (and Facility) *E. coli* Loads into Mill Creek at River Mile 13.6.

In the pre-facility scenario, the simulated in-stream levels from SSO 700 overflows exceed 300,000 cfu/100 ml, with an average density of approximately 135,000 cfu/100 ml over the 85 hours of detectable in-stream response. With the current facility, the simulated in-stream levels from the treatment facility and SSO 700 overflows exceed 65,000 cfu/100 ml, with an average density of approximately 8,100 cfu/100 ml over the 46 hours of initial stream response (e.g. 3/5/11 through approximately midday 3/6/11). With the future facility, the simulated in-stream levels from the treatment facility and SSO 700 overflows approach 15,000 cfu/100 ml, with an average density of approximately 3,500 cfu/100 ml over the same 46-hour period corresponding to the current facilityconditions. If the full 85-hour period that SSO 700 discharges in the pre-facility scenario were used to calculate the average *E. coli* densities in the current and future facility scenarios, these values would be less than 1,000 cfu/100 ml (970 and 610 cfu/100 ml, respectively). One final observationfrom this figure is that with the treatment facility on-line, the creek returns to low levels approximately 36 hours sooner than in the pre-facility scenario at this location.

Downstream profiles of in-stream water quality without background sources are presented in Figures 5-7, 10 and 11 for Day 2 (3/5/11), Day 3 (3/6/11) and Day 4 (3/7/11), respectively, of thestorm event. These are the days of the storm event when differences in the facility configuration are most clearly articulated in the model results. The figures also show the *E. coli* water quality standard of 235 cfu/100 ml as the dotted line. The figures show that the current facility achieves asignificant reduction in in-stream *E. coli* densities, dropping from approximately 200,000 cfu/100 ml in the pre-facility scenario to approximately 40,000 cfu/100 ml near the SSO 700 location. The benefit is propagated downstream to the mouth of the creek. At the mouth, *E. coli* levels are generally at least an order of magnitude smaller with the facility (current or future) than the pre- facility scenario on the three key days of the storm shown in these figures. Lastly, by Day 4 of the storm, in-stream bacteria levels in the scenarios with the treatment facility are at or below the water quality standard criterion of 235 cfu/100 ml in the lower eleven miles of the creek, while in the pre-facility scenario, in-stream levels from SSO 700 still near 50,000 cfu/100 ml. This suggeststhat additional days of attainment of water quality standards can be achieved with the facility scenarios if the loads from other background sources are not included.

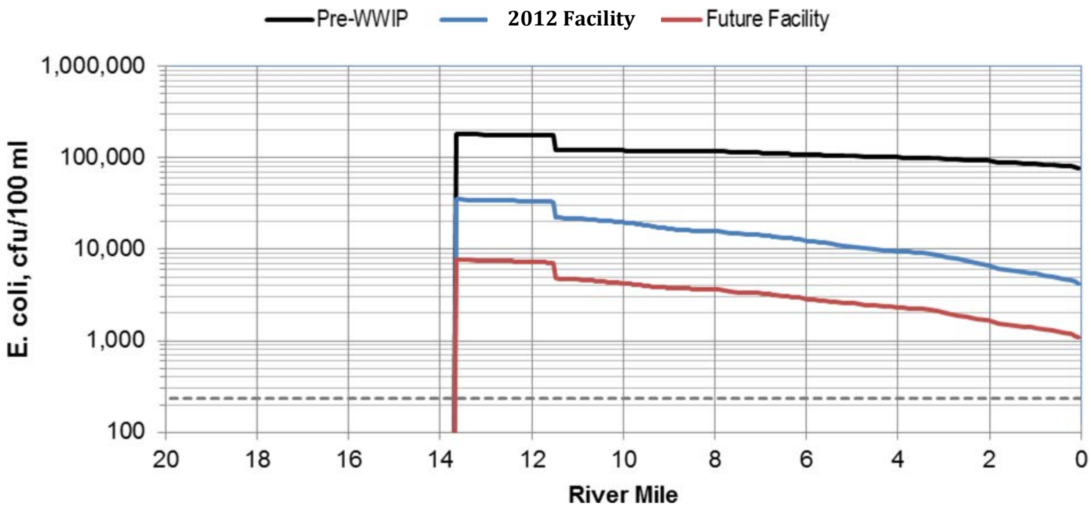


Figure 5-7. Water Quality Model Spatial Profile on 3/5/11 (Day 2) without Background Sources.

Monitoring data from the current SSO 700 demonstration treatment facility indicates that there hasbeen a significant reduction in the volume, duration and bacteria load of untreated discharges out of the SSO 700 outfall, as well as significant reductions in the total bacteria load released into Mill Creek near SSO 700, even for large storms (like the one used in this analysis) when SSO 700 overflows.

The results from the water quality modeling indicate that the current treatment facility improves water quality in and downstream of the SSO 700 outfall. In-stream *E. coli* levels were reduced by approximately 150,000 cfu/100 ml from the levels prior to the facility construction. This reductioncorresponds to ~ 70% reduction from pre-facility conditions. The contribution from SSO-700 to the overall in-stream bacteria levels drops from approximately 90% (pre-facility) to less than 10% at most in-stream locations. The demonstration treatment facility at SSO 700 provides over 13 miles of improvement in in-stream water quality, extending all the way to the mouth of the creek. At the mouth, in-stream bacteria levels were reduced by approximately 70,000 cfu/100 ml, corresponding to ~30% reduction from pre-facility conditions. Additional investment in one more storage tank at the demonstration treatment facility will significantly reduce loads and provide more improvement in in-stream water quality. Loads and in-stream water quality bacteria levels associated with facility improvements are approximately half of the current levels with the existing treatment facility. Evaluation of modeling scenarios without background sources suggest that additional days of water quality standard compliance can be achieved with the current and future facility, though a longer-term simulation would better quantify the benefits using this metric.

Recommendations to further define the benefits of the facility include extending the analysis period to a typical year so that performance and benefits, can be evaluated over a range of environmental and hydrologic conditions, and integrating the controls planned for other sources in the Mill Creek watershed into a modeling scenario so that the benefit of the SSO 700 wet weather facility can be put in context with the other investments in source controls.

6 Evaluating Effectiveness of the SSO 700 STF

6.1 FINDINGS FROM 2-YEAR EFFECTIVENESS STUDY

The information in this Section 6 was included in the original 2012 SSO 700 FRP in fulfillment of the requirements of the consent decree. It has not been substantively changed in this revision.

As previously described, the SSO 700 STF was required as a condition of a negotiated Consent Decree with the United Stated Environmental Protection Agency (USEPA) and the Ohio Environmental Protection Agency (OEPA). In conjunction with the Consent Decree, the June 2009 Final Wet Weather Improvement Plan (WWIP) specifies that MSDGC shall complete the SSO 700 Final Remedial Plan (FRP) by December 31, 2012. The Consent Decree also stipulates that a two- year performance assessment report of the facility, including recommendations for optimizing operations, be performed. To satisfy this requirement, the SSO 700 STF 2YES (Burgess & Niple, 2009) was completed by Burgess & Niple in December 2009 and was peer reviewed by Black & Veatch. The 2YES identified a number of physical facility improvements and operational modifications. Major findings of this study are summarized below:

- The system is capable of performing at least as well as was anticipated prior to the design.
- The system is sized properly to pump at least 30 mgd, store 3.6 MG, and to treat 15 mgd.
- The facility needs to be staffed during operation of the CEHRS and UV system.
- The UV system would operate more effectively and more easily if several relatively small modifications were made.
- The facility has experienced foaming events resulting from the agitation of a surfactant in the influent. The facility needs to be modified to provide anti-foaming sprays.
- Total Suspended Solids (TSS) data suggests two thirds (2/3) of the pollution released to the stream came from storage tank overflows. One fourth (1/4) to one third (1/3) of these releases can be eliminated by optimization of control strategies. These include the storage tank fill sequence and the system start and stop sequence.
- For those infrequent events when the downstream interceptor remains surcharged evenwhen the SSO 700 STF is in operation, a different means of handling CEHRS sludge is needed. Better backflow prevention at the interceptor should be investigated.
- Several smaller system modifications, which do not impact the facility treatment rating, but do impact system monitoring and reliability, were identified. These included sample pump location and handling of storm water in vaults.

The 2YES ultimately concluded that the facility was adequately sized and capable of producing an effluent quality equal to or better than that anticipated during pre-design. Although this was the conclusion of the 2YES, a number of physical and operational recommendations were made in order to ultimately improve the performance, reliability and safety of the SSO 700 STF; refer to Section 1.2.1.

6.1.1 2YES Physical and Operational Facility Findings

The 2YES provided detailed recommendations for changes to be made based on both physical and operational findings at the SSO 700 STF (Burgess & Niple, 2009). These recommendations were made in order to improve the performance, reliability, and safety of the STF. A summary of the recommendations presented in the 2YES is presented in Table 6-1 below.

Table 6-1. 2YES Physical and Operational Facility Recommendations

PHYSICAL DESIGN RECOMMENDATIONS	
AREA/ITEM	**DESCRIPTION**
Pump Station	Increase the set point stream water depth for diverting flow, thereby minimizing flow entering into SSO 700 STF
	Reinstall the influent sample pump at its current location but at a higher elevation
	Install a sump pump in the pump station valve vault. Discharge to wet well immediately under the top slab
	Seal the electric conduit entering the pump station valve vault so as to eliminate water intrusion
Yard Piping	Add sump pumps to all valve and meter vaults
CEHRS System	Reinstall the influent sample pump at its current location but at a higher elevation
	Spray nozzles or spray bars for foam control should be added to the CEHRS effluent drop box. If additional foam control is required, these devices may also be added at the CEHRS settling zone effluent launders
UV Disinfection System	Add a stilling well, foam control, and/or change the level device in order to secure the continuity of the UV level control signal
	Add spray nozzles or spray bars for foam control to the UV channel inlet and the UV channel
Miscellaneous Items	If foam is not controlled with spray nozzles and spray bars using plant water, it may be necessary for the SSO 700 STF to use an anti-foaming agent
OPERATIONAL DESIGN RECOMMENDATIONS	
AREA/ITEM	**DESCRIPTION**
Pump Station	Coordinate “off-elevation” set points for the pump station. CEHRS should be adjusted to ensure that the pump station always turns off first
Yard Piping	Electronic controls located in potentially submersible locations within valve and meter vaults should be modified from NEMA 4 rated to NEMA 6 rated enclosures

Table 6-1. 2YES Physical and Operational Facility Recommendations

Storage Tanks	Modify operation of ST-2 and ST-3 to operate as a single large tank. Close the master tank drain valve and open the individual tank drain valves on ST-2 and ST-3. If the modification does not eliminate short-term overflows from ST-2 while ST-3 is being filled at rates higher than 15 mgd, then piping, valving, and controls should be added to allow for the direct filling of ST-3
	Use of ST-1 should be modified to allow for the storage of CEHRS sludge during events when the downstream interceptor is above 8.0 feet, even with the maximum operation of SSO 700 STF
CEHRS System	Coordinate "off-elevation" set points for the pump station. CEHRS should be adjusted to ensure that the pumps station always turns off first
	Provide an alternate sludge handling methodology for times when the downstream interceptor is above 8.0 feet. Recommended alternative means is to provide ability to pump sludge to ST-1. Modify ST-1 operation to reserve top 500,000 gallons for sludge
OPERATIONAL DESIGN RECOMMENDATIONS	
AREA/ITEM	**DESCRIPTION**
CEHRS System	The startup sequence should be lengthened. This can be accomplished by either extending time or increasing flow rate. Increase current 30 minutes at 3 MGD to either 30 minutes at 6 MGD or one hour at 3 MGD
	Do not make process variable changes more often than once per half hour if at all possible
UV Disinfection System	Connect the UV system control panel to the plant control system
	Limit the travel of the UV effluent weir gate to eliminate flooding or draining of the UV channel on loss of level signal
	Shorten the UV system restart time to as short a time as allowed by the manufacturer
Process Control	Reduce the number of automatic control schemes from 3 to 1. Make the new scheme interactive so as to require the operator to select whether CEHRS operation or if sludge storage in ST-1 is anticipated
	Modify system start-up and shutdown set points to maximize flow to the Mill Creek WWTP and minimize flow handled at SSO 700 STF. Adjust set points to ensure that the pump station always stops operation before the CEHRS stops accepting flow
	Chemical dosages should be held in the following optimum ranges: 25 to 40 mg/l for coagulant; 1.5 to 2.0 mg/l for polymer; and 100 to 400 ml ballast sand / 1,000 ml influent
	Several operational/control lags have been identified when system control is shifted from manual to automatic mode. These relate to valve positions, CEHRS flow rates, and storage tank levels. These items should be corrected
	Do not make process variable changes more than once per half hour if at all possible

Table 6-1. 2YES Physical and Operational Facility Recommendations

6.2 FINDINGS FROM FACILITY EVALUATION REPORT

The SSO 700 STF was placed in operation on numerous occasions in response to wet weather conditions and excessive flows in the tributary sewer system during the STF's first year of operation. MSDGC observed several issues with the initial operation of the as-built facility. Black & Veatch was engaged to perform a peer review of the facility design. The purpose of the peer review was to provide evaluation of hydraulics, treatment process components, structures, support systems, and operations for achieving the original 30 MGD design intent for the SSO 700 STF. This peer review, the SSO 700 Facility Evaluation Report (Black & Veatch, 2011), was presented to MSDGC in May 2011. The 2011 Facility Evaluation Report addressed the observations and concerns expressed by MSDGC regarding design or operation of SSO 700 STF.

Table 6-2. Summary of MSDGC Reported Observations and Concerns

AREA/ITEM	DEFICIENCY DESCRIPTION
Diversion chamber hydraulics	Potential flooding of the influent chamber due to a downstream backflow condition overtopping the emergency overflow weir/opening
Diversion chamber/combined outfall sewer hydraulics	Flows greater than the 30 MGD peak design flow rate may be received, causing overloading of the combined outfall sewer and limiting the amount of flow that can be processed through the treatment facilities to avoid flooding the UV disinfection room
Combined outfall sewer	Storm sewer connection prior to outfall sewer headwall creates additional headloss that can potentially flood the UV disinfection room at peak flow and Mill Creek flood level conditions
Storage tank overflow pipelines	Backflow Tideflex® check valves between adjacent storage tanks add headlosses to the system making flow control difficult
Effluent discharge float	Effluent discharge float malfunctions
PACL storage tank	Size presents chemical delivery constraints
Solids recycled to pump station	Recycled solids impair CEHRS performance
Storage tank ringwall foundations	Cracking has occurred; seepage observed from the surface cracks when tanks are filling or full
Support system hydraulics	Valve vaults flood on a frequent basis during storm events; 4-inch drain pipes serving valve vaults appear to be undersized for the quantity of flow seeping into the valve vaults. Also, high water levels in the pumps station wetwell may result in back water conditions in the 4-inch drain piping
Overall facility operation	Operation of the facility is hindered by valve vault flooding and shorting out of valve actuators and/or their control systems
Overall facility electrical system	Power surges and power harmonics occur resulting in equipment failure
Treatment building HVAC system	Low make-up air supply in electrical and UV disinfection rooms; limited cooling of electrical room in summer

The findings and recommendations resulting from the peer review were focused on addressing concerns posed by MSDGC and on providing answers to the questions presented below:

- Can 30 MGD of excess flow be delivered to the storage/treatment facilities?
- Can 3.6 MG be stored in the storage facilities?
- Can 15 MGD be treated through the CEHRS facilities?
- What are the observed deficiencies in the CEHRS process facilities?
- What is the structural integrity of the storage tanks?
- Is the storage tank ringwall foundation design adequate?
- Was the ringwall foundation construction completed per the plans and specifications?
- What are the observed deficiencies in the facility support systems, including heating, ventilation and air-conditioning (HVAC), plumbing, electrical, and instrumentation and control systems?
- What improvements or modifications are required to achieve the original design intent of the facilities?

A summary of the recommendations presented in the SSO 700 Facility Evaluation Report is offered in Section 1.3.1 of this report.

6.2.1 Facility Evaluation Report SSO 700 STF Proposed Modifications

A summary of the proposed modifications outlined in the SSO 700 Facility Evaluation Report (Black& Veatch, 2011) is provided in Table 6-3. These modifications were presented based on meeting the original 30 MGD design intent of the SSO 700 STF, and were limited to issues within the facility and not in the outside collection system or system model.

Table 6-3. Summary of Proposed Modifications

AREA/ITEM	MODIFICATION DESCRIPTION
Diversion chamber hydraulics	Install a flexible flap gate on the downstream side of the emergency overflow weir/opening at El. 545.50
Diversion chamber / combined outfall sewer hydraulics	Lower the two (2) 3-ft square sluice gates at the entrance to the influent pump station wetwell to the extent necessary to maintain the maximum wetwell evaluation of 535.00 ft when influent flow exceeds 30 MGD
Combined outfall sewer	Construct a new parallel outfall sewer as part of a facility expansion project for design flows greater than 30 MGD. Connect the existing 18-inch storm sewer to the new outfall sewer
Storage tank overflow pipelines	Remove the Tideflex® check valves on the 36-inch pipelines between adjacent storage tanks
UV channel control	Install foam control to improve UV level control

Effluent discharge floats	Replace the existing anchors with larger anchors or install point level device monitors in lieu of floats
Instrumentation & Controls standards	Upgrade instrumentation and controls system to meet MSDGC Design Documentation Standards for SCADA/PLC and I&C Systems
PACL storage tank	Provide an additional tank in another location, or possible a single larger tank; building modifications may be required
Solids recycled to pump station	Install a new solids sump and solids pump to pump solids directly to additional onsite sludge storage
Storage tank ringwall foundations	Remedial work should be performed that both seals the cracks and strengthens the concrete ringwall
Support system hydraulics	Replace portions of the existing valve vault drainage system network with larger pipelines. Install a flap gate on the end of the proposed larger drain pipe to eliminate any back flows from the pump station wetwell. In addition, relocate valve vault actuators to above ground to eliminate system shutdowns
Overall facility operation	Replace the system based on assessment
Treatment building HVAC system	Add wall louvers and automatic dampers to furnish make-up air supply in electrical and UV disinfection rooms. Incorporate HVAC improvements to satisfy UV control panel temperature requirements
Polymer system	Install emulsion polymer system to improve CEHRS startup efficiency

6.3 SSO 700 STF OPERATING STATISTICS (2008 – 2011)

A reasonably complete data set is available for SSO 700 STF operation, and SSO 700 recorded overflow data. Some upstream interceptor sewer flow data for the three-year period from July 2008through June 2011 is also available. Some key statistics are developed in this section for that three-year period to establish baseline operating conditions prior to making any proposed facility improvements.

April and May of 2011 are excluded from the analysis due to over 18 inches of rainfall which occurred during those two months. This is approximately double the normal amount for the two- month period and is not representative of typical conditions. During this extreme wet weather period, the CEHRS treatment facility operated for 539 hours, including 12 continuous days in April.During the other 34 months of the analysis period, the facility operated a total of 778 hours, or an average of a little less than 24 hours per month. Also, during this two month period, the storage tanks overflowed a total of 85 MG. This is compared to 72 MG for the remaining 34 months, an average of approximately 2 MG per month. The facility continued to be operated at maximum capacity even though the storage tanks were full. This limited the untreated overflow volume fromthe SSO 700 overflow manhole to approximately 5 MG during April and May of 2011. The total overflow volume for the 34 months period was 40 MG, an average of just over 1 MG per month.

In spite of the presence of the SSO 700 STF, which removes up to 30 mgd of peak flow from the

EBMCI for about 3 hours, and 15 mgd thereafter, overflows from the SSO 700 overflow manhole downstream of SSO 700 STF still occur an average of eight (8) times per year. This is an indicator ofthe extent to which the EBMCI is undersized, and the amount of surcharging that occurs in this overloaded interceptor sewer. Many segments of the EBMCI have capacity to convey less than 3 times the average dry weather flow, a condition that will be made worse when upstream relief sewers are tied into it; refer to Section 4.2. Sewer depths in the 3.5-foot diameter EBMCI must reach8 feet at the SSO 700 manhole for an overflow to occur. The SSO 700 STF overflow weir is overtopped when depth of flow in the EBMCI reaches 4.5 feet. The most important contributor to SSO 700 overflows is a lack of downstream interceptor sewer capacity, as the sewer quickly fills from the contributions of 8 Combined Sewer Overflow (CSO) underflow sewers located within several thousand feet downstream of the SSO 700 overflow manhole.

A portion of the overflow from SSO 700 includes solids from the CEHRS process that are returned tothe interceptor sewer, making the discharge more concentrated than it would be without the facility, or if there were solids storage facilities available at the facility. Any time that the CEHRS facility is operated, it produces a waste solids stream of approximately 350 gallons per minute (gpm) or about 0.5 mgd if operated for a full day. It was learned during the two-year performance testing period that these solids could not be returned through the treatment process without upsetting the process. Provision of solids storage at the SSO 700 STF site would help solve this problem. An additional 0.6 MG of solids storage could potentially capture more than 85 percent of the solids that are a part of the SSO 700 discharge. The solids capacity could be reserved in ST-1, as suggested in the 2YES, but this would reduce the overall storage capacity of the storage facilities from 3.6 MG to 3.0 MG. Alternately, an extra 1.2 MG storage tank could be provided, thereby increasing the total available storage volume to 4.2 MG while providing the needed 0.6 MG for solids storage. The extra storage tank would reduce both the annual tank overflow volume and the SSO 700 overflow volume by approximately 10 percent, while potentially eliminating more than 85percent of solids that would otherwise be discharged by SSO 700.

Fifty wet weather events occurred from the completion of construction of the SSO 700 STF until theend of March 2011. The 3.6 MG of storage capacity was exceeded 33 times, about 67 percent of the time. Six tank overflows occurred due to the CEHRS being out of service (three times during replacement of fine screens; three times due to control malfunctions). Storage tank overflows occurred during 20 percent of the events due to the tanks being partially full at the beginning of an event or to some spillage from ST-2 before ST-3 was completely filled.

7 SSO 700 Final Remedial Plan Components

The goal of the FRP is to eliminate sanitary sewage overflows from SSO 700. The proposed SSO 700 FRP consists of two components: Component No. 1 – Upgrades to the existing SSO 700 Storage and Treatment Facility (STF), and Component No. 2 – Integration with the Lower Mill Creek Final Remedy (LMCFR) for flows that remain. Component No. 1 is complete and is fully detailed in Section 4.3. A summary of the capital improvements that comprised this component is included in Section 7.1 for completeness.

7.1 SSO 700 FRP Component No. 1 – Upgrades to Storage and Treatment (STF) Facility (Completed)

In 2013 MSD initiated a watershed-based approach to its operations with the intent to maximize conveyance and treatment capacity of the wastewater system during wet weather. MSD operations focused attention on the operating wet weather assets with the ultimate objective of optimizing their performance at a localized area as well as in the context of a watershed, in coordination with other MSD assets. The SSO 700 Wet Weather Storage and Treatment Facility (STF) was identified as an important MSD asset that could provide enhanced control of wet weather overflows in the Mill Creek basin. Initially designed to reduce overflows from SSO 700, this facility is now part of an operational strategy that broadens its use for basin wide overflow reduction.

Only under extreme conditions, flow from the separated system overtops the diversion gate to protect against upstream flooding. Otherwise, any overflow that occurs at the SSO 700 constructed outfall structure is attributable to backflow from the combined flow downstream. In addition to these operational improvements, MSD advanced the following three capital projects during the Bridge Phase, which accomplished the upgrades listed in Table 7-1:

10241825 SSO 700 Operational Improvements Project
This project took care of the faulty instrumentation issues that kept the facility from functioning reliably. Dealt with instrumentation and controls as well as relocating actuator electronics above ground.

10241820 SSO 700 Facility Improvements Project
This project completed the bulk of the items committed to in the FRP including the additional storage tank, additional coagulant storage tank, CEHRS solids pump station, new polymer system, and A/C upgrades for UV. This effort also provided a separation of the facility outfall so that discharges from CEHRS could be differentiated from storage tank overflows.

10142070 SSO 700 Disinfection Improvements Project
This project provided chemical disinfection for facility overflows from the additional tank that was installed in the previous project.

Table 7-1. Summary of Completed Upgrades

NO.	AREA/ITEM	MODIFICATION DESCRIPTION
1	Interceptor Chamber / Combined Outfall Sewer Hydraulics Controls	Provide controls to allow throttling of the two (2) 3-foot square sluice gates at the entrance to the influent pump station wet well
2	PACL Storage Tank	Install a new PACL storage tank adjacent to the existing bulk storage tank; perform necessary building modifications for additional tank
3	CEHRS Solids Pump Station	Install a new CEHRS solids pump station, and new solids force main between the new pump station and proposed storage tank
4	Support System Hydraulics	Replace portions of the existing valve vault drainage system network with larger pipelines. Install a flap gate on the end of the proposed larger drain pipe to eliminate any back flows from the pump station wet well. In addition, relocate valve vault actuators to above ground to eliminate system shutdowns
5	Valve Actuators	Replace all valve actuators with above-grade standard electric actuators, and incorporate actuator protection from vehicular traffic
6	Treatment Building HVAC System	Evaluate and design needed heating, ventilation, and air conditioning (HVAC) improvements for the control and UV rooms
7	Foam Control	Install a foam control system. Install foam control to improve UV level control
8	Instrumentation & Controls (I&C) Standards	Upgrade I&C systems, thereby eliminating existing DeviceNet, Foundation Fieldbus, and Profibus networks, to meet MSDGC Design Documentation Standards for SCADA/PLC and I&C Systems
9	Electrical System Improvements	Electrical System improvements, including upgrade of Influent Pump No. 1 with an 18 pulse AFD
10	Polymer System	Replace or upgrade the existing polymer system to improve CEHRS startup efficiency
11	Overall Facility Operations	Modify standard operating procedures based on continual assessment
12	Additional Storage Tank	Install a new 1.2 MG storage tank (ST-4) for storage of CEHRS solids and/or facility influent; associated tank appurtenances and yard improvement
13	Treatment & UV Building HVAC System	Construct a new air-conditioned room in the UV building to house the UV Control Panels (required by UV manufacturer's equipment for proper operation)
14	Water Pressure Booster System	Install a new water pressure booster system with break tank and air gap to supply NPW loads at the facility
15	Coordinated control implementation	Implement coordinated control algorithm at the STF to enable use of the facility to minimize wet weather capacity constraints downstream and reduce overflow in other parts of the basin.
16	New Storage Tank Piping	Modify proposed piping for new tank to eliminate overflow to Mill Creek and provide piping from ST4 to CEHRS. This will provide greater flexibility to utilize the new tank for influent storage and flow to CEHRS. (approx. $370K)
17	Disinfection updates	Evaluate, design, and implement disinfection improvements.

7.2 SSO 700 FRP Component No. 2: Default SSO 700 Final Remedy Integration with Lower Mill Creek Final Remedy (LMCFR)

The scope of the Default SSO 700 Final Remedy is based on the assumption that all projects listed in the Final WWIP Attachment 2 that are within the SSO 700 watershed would be completed. FRP Component No. 2 also recognizes that Component No. 1, which includes the upgrades listed in Table 7-1 are complete and those upgrades alone are not capable of fully eliminating sanitary sewage overflows from SSO 700. This is primarily due to the current analysis of capacity limitations of the two major combined sewer interceptors that convey flow from the SSO 700 tributary area (and SSO 700 STF) to the Mill Creek WWTP.[1] Given the combined discharge at the SSO 700 outfall from the downstream Mill Creek interceptors, an integrated watershed regional approach and solution in the Lower Mill Creek will be required to properly and cost-effectively address SSO 700 overflows and the other overflows in the sewershed.

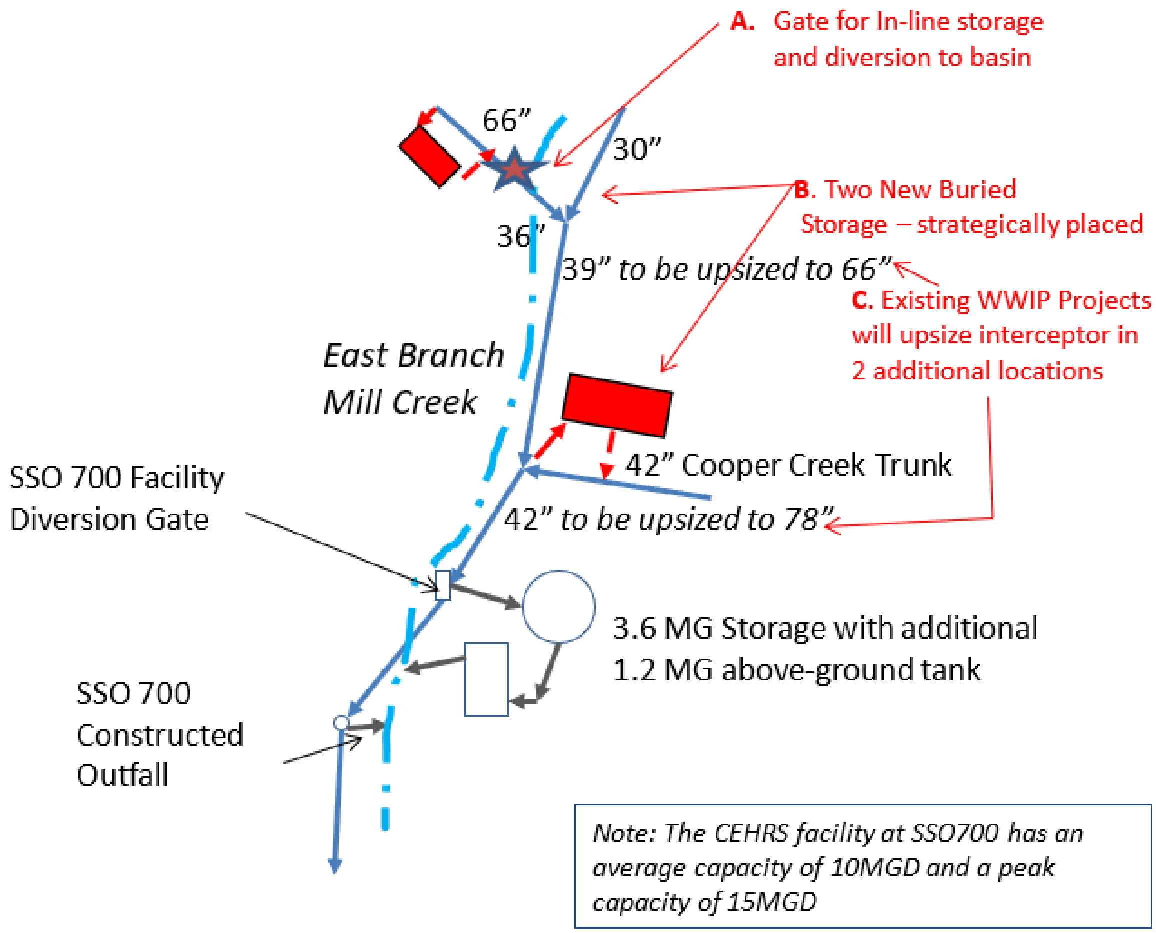
Since submission of the FRP, there have been extensive discussions with the Regulators about the proper approaches for the Lower Mill Creek Partial Remedy (LMCPR) and Lower Mill Creek Final Remedy (LMCFR). These discussions have included applying integrated planning in the development of the remedial measures consistent with US EPA's June 2012 Integrated Planning Approach Framework, and July 2013 Frequently Asked Questions on Integrated Municipal Stormwater and Wastewater Planning (Integrated Planning). The approved LMCPR was developed in part utilizing Integrated Planning concepts and other watershed planning methods, particularly for the Lick Run watershed.

7.3 Default SSO 700 Final Remedy

The objective of the SSO 700 Final Remedy Plan is the goal of eliminating sanitary sewage overflows from the SSO 700 outfall. Achieving that goal is inextricably linked to the Lower Mill Creek Final Remedy (LMCFR) and therefore, the chosen SSO 700 Final Remedy must be closely coordinated with and implemented as part of that final solution. Assuming all other WWIP projects in the SSO 700 watershed have been completed, the following solution is proposed as the default final remedy for SSO 700 to meet the requirements of the IPCD. This default final remedy includes an additional 24.8 MG of storage (both in-line and off-line), a total of four storage tanks at the SSO 700 STF with a combined volume of 4.8 MG (already constructed), and the elimination of the overflow "window" above the facility's diversion control gate located on the interceptor (enabling complete isolation of the upstream sanitary system from the downstream combined system). The existing CEHRS and disinfection systems at the SSO 700 STF will cease operation after construction of the proposed default remedial measures. A conceptual layout of the default final remedy is presented in Figure 7-1.

[1] Information about the interceptor capacity limitation is included in the December 31, 2012 FRP and on the SSO 700 FTP electronic website: https://app.e-builder.net/public/publicLanding.aspx?QS=4070b7e75f554d8ebf9b81ff29ad37ba.

Figure 7-1. Conceptual Layout of Default SSO 700 Final Remedy and Existing WWIP Project Assumptions



The analysis below is updated from a previous analysis that used recorded flow volumes in order to initially size a default solution. It now represents MSD's best forecast of potential future flows that would need to be addressed by the Final Remedy where all currently required WWIP projects are completed.

Model Calibration and Validation

In 2017, the East Branch Mill Creek Basin was calibrated using 2012 flow monitoring data. The calibration included hydraulic updates including correction of manhole depths and surcharge depths based on field measurements and whether the manholes were blind or found to be bolted. As SSO 700 STF was operated manually during the calibration period, the operational data, such as pump on and off times, were used to simulate STF operation during for each month during calibration.

The dry weather calibration was based on three flow types developed using SSOAP: dry weather flow (sanitary or DWF), ground water intrusion (GWI), and rainfall derived inflow & infiltration (RDII). DWF was calibrated using 48-hour low flow periods for March through December 2012. DWF was updated in the model using the flow patterns and average flows for each metershed. The average flows were distributed to the inflow points as proportional changes to the existing DWF rates. The existing rates were developed in 2001 using water meter records.

GWI flow was used to develop local aquifers fed by surface subcatchments. The aquifer parameters were adjusted to best follow the monthly trends in low flow periods.

Wet weather calibration statistics was developed using continuous simulation of the entire calibration period. Statistics for wet weather calibration were developed for storms with at least 0.5 inch of rain and not impacted by snowfall, snowmelt, or data quality issues (rain or meter). For the continuous period, the STF was modeled using control rules rather than observed data.

Initial parameters for the RDII portion of the hydrographs were from the SSOAP analysis. These parameters were developed and adjusted on a metershed basis. The parameters were then adjusted for each month as needed to improve the calibration of that month's storms. Calibration results are summarized in Table 7-2.

Table 7-2. Wet Weather Flow Calibration Summary

Metershed Flow Monitor	Number of Qualifying Events	Number of Qualifying Events Meeting Calibration Tolerances for Peak Flow, Volume, and Depth	Percent of All Qualifying Events within 2012 Meeting Calibration Tolerances			
			Peak Flow Only	Volume Only	Peak Depth Only	Peak Flow, Volume, and Depth
MC-EB-030	25	24	96	100	100	96
MC-EB-019	19	12	100	100	63	63
MC-EB-026	23	14	74	83	65	61
MC-EB-027	23	14	78	61	100	61
MC-EB-036	25	15	68	68	100	60
MC-EB-031	21	15	95	76	100	71
MC-EB-016	25	15	80	88	68	60
MC-EB-033	20	14	95	75	90	70
MC-EB-035	21	15	90	76	100	71
MC-EB-017	23	14	96	91	61	61
MC-EB-075	21	13	90	86	76	62
MC-EB-071	21	14	81	67	100	67
MC-EB-004	20	13	85	75	100	65
MC-EB-005[1]	20	8	NA	NA	40	40

[1]MC-EB-005, a level sensor installed in the interceptor near SSO 700, was not used as a calibration meter, meaning the model parameters were not calibrated to match model output to observed data at this location. Comparison of

Table 7-2. Wet Weather Flow Calibration Summary

Metershed Flow Monitor	Number of Qualifying Events	Number of Qualifying Events Meeting Calibration Tolerances for Peak Flow, Volume, and Depth	Percent of All Qualifying Events within 2012 Meeting Calibration Tolerances			
			Peak Flow Only	Volume Only	Peak Depth Only	Peak Flow, Volume, and Depth

model results to observed data at MC-EB-005 are provided for reference but are not expected to achieve the 60% target. Additionally, because this was a level sensor, the reported results only include depth.

During development and calibration of the EBMC in 2015, flow and water quality data were collected to characterize overflow and stream water quality. This data was collected to calibrate models and prioritize projects based on water quality impacts. For 2015, the five flow monitors were in the same locations as the 2012 data. For the hydraulic model, this data was used as validation of the calibration to 2012 data.

The model was run using 2015 rainfall data as a continuous period so the aquifers could stabilize to observed rainfall. The validation storms were selected for seasonal variation, and differing durations and intensities. Table 7-3 below summarizes the validation results.

Table 7-3. Wet Weather Flow Validation Summary

Metershed Flow Monitor	Number of Qualifying Events in 2015	Number of Selected Events Meeting Calibration Tolerances for Peak Flow, Volume, and Depth	Percent of All Qualifying Events in 2015 Meeting Calibration Tolerances			
			Peak Flow Only	Volume Only	Peak Depth Only	Peak Flow, Volume, and Depth
MC-EB-030	9	6	100	67	100	67
MC-EB-019	9	2	79	33	67	22
MC-EB-026	8[1]	0	38	13	50	0
MC-EB-017	5[2]	0	100	40	40	0
MC-EB-016	6[3]	0	67	33	67	0
MC-EB-005[4]	9	6	NA	NA	6	6

[1] Meter MC-EB-026 was missing data during the 8/18/2015 validation event.
[2] MC-EB-017 was not yet installed for 1/2/2015, 3/3/2015, and 7/28/2015 events. The quality of data for the 10/27/2015 event were of poor quality at this meter and could not be used for validation.
[3] MC-EB-016 was not yet installed for 1/2/2015, 3/3/2015, and 7/28/2015 events.
[4]MC-EB-005, a level sensor installed in the interceptor near SSO 700, was not used as a calibration meter, meaning the model parameters were not calibrated to match model output to observed data at this location. Comparison of model results to observed data at MC-EB-005 are provided for reference but are not expected to achieve the 60% target. Additionally, because this was a level sensor, the reported results only include depth.

Default Remedy Development

An evaluation of the size storage needed to eliminate sanitary sewage discharges from SSO 700 up to the 2-year storm was performed. Based on that evaluation, the 2-year storm peak inflows have been determined for the sizing of future default storage upstream of SSO 700. Table 7-4 shows the flows and volumes at key comparison points in the model. As shown by the table, the upstream overflows are reduced by the other WWIP projects and the Component No. 1 projects, and fully eliminated by the default final remedy. This volume is conveyed down to the STF where the diversion gate operates to limit flows to the combined interceptor downstream.

Table 7-4 Flows and Volumes for 2-Year 24-Hour NRCS Storm

		2017 Conditions	WWIP Projects Completed, Reliability Improvements, 4th Tank online	WWIP Projects, CEHRS Removed, 4th Tank plus Default Storage volume of 24.8 MG
Upstream Overflow	Outfalls (MG)	0.2	0.2	0
	Flooding MH (MG)	5.7	2.8	0
Interceptor Flow from Upstream to SSO 700 STF Diversion	Total Volume (MG) Day of & After Storm (48 Hr)	47.9	50.9	30.5
	Peak Flow (cfs)	75	101.4	38.8
CEHRS	Treated to Mill Creek (MG)	11.3	10.5	0
	Sludge Volume to Interceptor (MG)	0.6	*	0
	Tank Drainage to Interceptor (MG)	1.4	2.3	5.0
	Tank Overflow to Mill Creek (MG)	12.7	6.8	0
SSO 700 Existing Outfall (constructed)**	Total Volume (MG)	0.1	3.5	0
	Peak Flow (cfs)	2.5	25.5	0

Interceptor Flow to Downstream from SSO 700 Outfall* **	Total Volume (MG) Day of & After Storm (48 Hr)	25.2	26.3	41.8
	Peak Flow (cfs)	28	28.4	29.3
WWIP Projects, CEHRS Removed, 4th Tank plus Default Storage volume of 24.8 MG	Volume In-Line Storage (North Basin) (MG)	n/a	n/a	0.7
	Volume Tank North (MG)	n/a	n/a	2.8
	Peak Inflow Tank North (cfs)	n/a	n/a	16.4
	Volume Tank Cooper (MG)	n/a	n/a	21.3
	Peak Inflow Tank Cooper (cfs)	n/a	n/a	82.1

Notes:

** CEHRS sludge is pumped to 4th STF storage tank for later discharge to interceptor to WWTP when interceptor capacity available.*

***The current operational strategy at SSO 700 STF effectively isolates the separated sewer system from the combined sewer system. Under the Final Default Remedy, except extreme conditions, any overflow that occurs at the SSO 700 constructed outfall structure is attributable to backflow from the combined flow downstream.*

****The total volume and peak flow to interceptor downstream of SSO 700 will be accounted for in the planning of the LMCFR.*

As summarized in Table 7-5, a total storage volume of 24.8 MG is required as a default final remedial plan for SSO 700 in addition to and in connection with the LMCFR. The default SSO 700 Final Remedy includes (a) 0.7 MG of in-line storage created by the addition of a control gate at the downstream end of the WWIP projects of Sharonville/Evendale Trunk Sewer to SSO 700, SSO 1048 Conveyance Sewer Phases 1 and 2, and SSO 587 Conveyance Sewer; (b) two proposed underground storage facilities upstream of SSO 700 overflow pipe and diversion/isolation gate with a combined capacity of 24.1 MG. These two future storage facilities would be activated by wet weather and would be dewatered by pumps and a force main back to the adjacent receiving sewer. Any remaining discharge from SSO 700 that results from backflow from the combined sewer area downstream of SSO 700 shall be controlled by the LMCFR. Because of the linkage of the SSO 700 FRP with the downstream interceptors, dewatering of the tanks must be coordinated using MSD's Wet Weather SCADA System to maximize conveyance to treatment at the Mill Creek WWTP.

Table 7-5 Total Storage Volume Needed to Eliminate Sanitary Sewage Overflows within the SSO 700 Sewershed; modeling completed 2017-2018

Storage	Volume, MG
In-Line Storage	0.7
North Basin	2.8
Cooper Basin	21.3
TOTAL	**24.8**

The size of the storage basins required is taken from modeled overflow volumes as determined using MSDGC's fully calibrated and validated SWM model Version 5.0.17 within the SSO 700 sewershed. The storage volume sizing is based on a scenario where the existing downstream backwater affects continue even after a future LMCFR is fully implemented. The default remedy for SSO 700 requires additional land acquisition, separate from land at the existing facility site. There is available and adequate vacant land in the proximity of the anticipated storage locations.

The proposed North Basin is adjacent to an existing 66-inch sewer that flows into a 36-inch sewer under a railroad and connects with other interceptors. The 66-inch sewer was built in 1996 as a replacement for the 1956 36-inch sewer. The North Basin is modeled as filling by gravity using a side weir off the 66-inch sewer. To use the available capacity of the 66-inch sewer, an in-line gate was modeled at the entrance to the downstream 36-inch pipe. This gate operates to store flows as a full pipe. The proposed Cooper Basin is modeled as a side weir to reduce the surcharge at the SSO 700 diversion structure and reduce overflows at SSO 700. In addition to the Cooper Basin weir, a gate diversion was modeled to divert additional flows when the SSO 700 STF tanks were about to overflow. Just before the tank overflow occurs, the Cooper Basin gate opens to reduce water levels at the SSO 700 diversion that in turn reduces pumping to the STF and prevents tank overflows. This allows for the capture and treatment of flows that would have entered Mill Creek without treatment.

At the SSO 700 STF, in the same chamber wall as the existing Diversion Gate, is a high-level orifice or "window." This high-level orifice connects the upstream sanitary interceptor above SSO 700 STF with the downstream combined interceptor. This existing opening has a flap gate to prevent flows from the combined interceptor from reaching the STF diversion. In the partial remedy scenarios, this orifice allows flows from the sanitary interceptor to flow to the combined interceptor, which reduces the surcharge in the sanitary interceptor and reduces flooding manhole volumes. In the default Final Remedy, the storage basins reduce the interceptor surcharge and prevent the flooding manholes. As the high-level orifice is unneeded, the orifice will be closed to prevent flow from the sanitary interceptor to the combined interceptor. The closure also allows higher water levels in the sanitary interceptor which produces more efficient use of the storage basins and in-line storage in the interceptor.

7.4 Final Default Remedy Estimated Quantities and Assumptions

Preliminary storage basin sizing was based on capture of the 2-year storm with existing flow conditions downstream of SSO 700 as a conservative assumption that conditions downstream will be no worse. Estimated preliminary quantities, dimensions, and assumptions used for development of preliminary costs are as follows:

STF and CEHRS

- Current control rules for operating the Diversion Gate and the STF are maintained
- CEHRS is no longer operated
- Tank 4 is used for storage of sewage/solids (only half of the volume of tank is needed to meet the 2-year storm criteria)
- High level orifice above Diversion Gate is removed in Final Default Remedy to fully separate sanitary and combined areas during high water situations.

North Storage Basin

- 150 linear feet of 66-inch diameter gravity influent sewer; average depth of 15 feet
- 150 linear feet of 16-inch diameter force main; average depth of 15 feet
- Buried, reinforced concrete storage basin:
    - 210-foot long by 180-foot wide outside dimensions
    - 10-foot average side water depth
    - 25-foot depth to bottom of base slab
- Dewatering required for all construction
- $250,000 land acquisition allowance (2006 dollars)
- Diversion structure with in-line gate and Real Time Control on main sewer line

Cooper Creek Storage Basin

- 850 linear feet of 66-inch diameter gravity influent sewer; average depth of 18 feet
- 800 linear feet of 16-inch diameter force main; average depth of 15 feet
- Buried, reinforced concrete storage basin:
    - 500-foot long by 420-foot wide outside dimensions
    - 15-foot average side water depth
    - 33-foot depth to bottom of base slab
- Dewatering required for all construction
- $1M land acquisition allowance (2006 dollars)
- Diversion structure with offline RTC gate

7.5 Preliminary Capital Costs – Default Final Remedy

Preliminary costs were developed in 2017 using the LMCPR Costing Tool, which estimates costs in 2006 dollars. For consistency with the LMCPR Revised Plan, a 35 percent contingency factor and the equations and allowances for soft costs were used to develop the total project cost. For consistency with the SSO Final Remedial Plan Report, costs are trended to 2013 dollars. The preliminary costs are summarized in Table 7-6.

Table 7-6 Preliminary Capital Costs of off-site storage, as estimated in 2018

Storage Basin/ Capacity	Derived using MSD LMCPR Costing Tool in 2006 $			2013 $
	Base Construction Cost, $million	Total Construction Cost, $million	Total Project Cost, $million	Total Project Cost, $million

North Storage Basin 2.8 MG	*$7.38*	*$10.16*	*$13.30*	*$15.26*
Cooper Creek Storage Basin 21.3 MG	*$38.32*	*$52.76*	*$66.47*	*$76.25*
Subtotal FRP off-site 24.1 MG storage	**$45.70**	**$62.92**	**$79.77**	**$91.51**

The above analysis is conservative and includes the following assumptions regarding the SSO 700 Storage/Treatment Facilities, located at the approximate locations depicted in Figure 7-1:

- Reliability improvements, which include a 1.2 MG above-ground storage tank. Actual stored volumes of sewage will vary with the details of STF operation and the flow pattern of each storm.
- The above analysis utilized the current operational strategy of the SSO 700 STF when treating excess flows. All strategies for operating the diversion gate were functional in the model and were initiated by high water readings at 34107020 (Ross Run) triggering the restricted flows starting diversion to the STF.
- North Basin will be dewatered when the local interceptor is approximately half pipe which assumes downstream capacity at SSO 700 STF and beyond. This assumption will need to be coordinated with the LMCFR.
- Cooper Basin will be dewatered when the interceptor at the STF diversion weir is below the weir crest and is below the depth used by the STF to trigger drainage of the four STF tanks to the interceptor. To be coordinated with the LMCFR.
- More detailed modeling and design and development of site specific control strategies will impact the needed size of storage basins. Details that impact size of the basins include distance from SSO 700 STF, interceptor depth when diversion occurs, volume of storage used at SSO 700 STF, allowable surcharge of interceptor at SSO 700 STF, rate and volume of flow through SSO 700 STF diversion gate structure, and available downstream interceptor capacity based on the future LMCFR. System improvements that remove storm water from the sanitary sewers will reduce the peak flows and flow volumes to be managed.

7.6 Estimated Operation and Maintenance Costs – Final Default Remedy

Table 7-7 provides the estimated operation and maintenance costs based on the assumptions that follow in Tables 7-8, and 7-9. Preliminary costs were developed in 2017 using the LMCPR Costing Tool, which estimates costs in 2006 dollars. However, for consistency with the LMCPR Revised Plan and throughout the SSO Final Remedial Plan report, costs below are reported in 2013 dollars.

Table 7-7 Operation and Maintenance Costs

Storage Tanks O&M Cost Estimate					
Cost Category				**Unit Costs**	**Annual O&M Cost**
Power		**35317**	**kwh**	**$0.10**	**$3,531.73**
Labor		**192**	**hr**	**$45.00**	**$8,640.00**
Flushing with potable water:		**72**	**flushes**	**$66.67**	**$4,800.24**
	Total O&M Cost Estimate:				**$16,971.97**

Table 7-8 North Storage Tank O&M Assumptions

North Storage Tank O&M Estimate Assumptions:					
Total events per year:				4	events/year
Average Volume:				1.4	MG
Dewater rate (one 3 MGD pump):				3	MGD
Dewatering duration per event:				11.2	hours/event
Dewatering duration per year:				44.8	hours/yr
Major equipment:					
	Dewatering pumps	20	hp	14.91	kw
	Est. Power usage:			*15*	*kw*
Energy Consumption:				*672*	*kwh*
Labor:					
	No. of persons at 4 hr each after each event for cleanup				2
	Total annual labor hours:				32
Flushing tank post event: a total of 3 flushes/event; using potable water.					$66.67/flush

Table 7-9 Cooper Creek Storage Tank O&M Assumptions

Cooper Creek Storage Tank O&M Estimate Assumptions:					
Total events per year:				20	events/year
Average Volume:				11.6	MG
Dewater rate (six 3 MGD pumps):				18	MGD
Dewatering duration per event:				15.5	hours/event
Dewatering duration per year:				309.3	hours/yr
Major equipment:					
	Dewatering pumps	25	hp	18.6	kw
	Total (6 pumps)			111.8	kw
	Est. Power usage:			*112*	*kw*
Energy Consumption:				*34645*	*kwh*
Labor:					
	No. of persons at 4 hr each after each event for cleanup				2
	Total annual labor hours:				160
Flushing tank post event: a total of 3 flushes/event; using potable water.					$66.67/flush

Appendix A

Abbreviations

ABBREVIATIONS

AMCI	Auxiliary Mill Creek Interceptor
bgs	Below Ground Surface
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CAGIS	Cincinnati Area Geographical Information System
CAPP	Capacity Assurance Program Plan
CEHRS	Chemically Enhanced High-Rate Sedimentation
CEPT	Chemically Enhanced Primary Treatment
cfs	Cubic Feet per Second
CIP	Capital Improvement Program
CSO	Combined Sewer Overflow
CWA	Clean Water Act
DWF	Dry Weather Flow
EBMCI	East Branch Mill Creek Interceptor
EHRT	Enhanced High-Rate Treatment
EL.	Elevation
EPA	Environmental Protection Agency
ESA	Environmental Site Assessment
^{o}F	Degrees Fahrenheit
FRP	Final Remedial Plan
ft	Feet
GCWW	Greater Cincinnati Water Works
GPD or gpd	Gallons per Day
GPM or gpm	Gallons per Minute
HRT	High Rate Treatment
HP or hp	Horsepower
I/I	Infiltration / Inflow
I/O	Input/ Output
Kw or kw	Kilowatt
LMC	Lower Mill Creek
LMCFR	Lower Mill Creek Final Remedy
LMCPR	Lower Mill Creek Partial Remedy
MCC	Motor Control Center
MG	Million Gallons
MGD	Million Gallons per Day
mg/L	Milligrams per Liter
MH	Manhole
MSDGC	Metropolitan Sewer District of Greater Cincinnati
NAD	North America Datum
NaOCl	Sodium Hypochlorite
O&M	Operation & Maintenance
OAC	Ohio Administrative Cost
OEPA	Ohio Environmental Protection Agency
OPCC	Opinion of Probable Construction Cost

OSHA	Occupational Safety & Health Act
OS-1	Operating Strategy No. 1
OS-2	Operating Strategy No. 2
OS-3	Operating Strategy No. 3
PAA	Peracetic Acid
PACl	Polyaluminum Chloride
PLC	Programmable Logic Controller
POTW	Publicly Owned Treatment Works
PRV	Power Roof Ventilator
PVC	Polyvinyl Chloride
RDI/I	Rainfall Derived Inflow/Infiltration
RTC	Real Time Control
RTK	Real Time Kinetic
SSO	Sanitary Sewer Overflow
SSO 700	Sanitary Sewer Overflow 700
SSO 700 STF	Sanitary Sewer Overflow 700 Storage and Treatment Facility
sq ft or sf or ft^2	Square Feet
STF	Storage and Treatment Facility
ST-1	Storage Tank No. 1
ST-2	Storage Tank No. 2
ST-3	Storage Tank No. 3
SWD	Side Water Depth
SWM	System Wide Model
SWMM	Storm Water Management Model
SWMP	System Wide Management Plan
TBD	To Be Determined
TM	Technical Memorandum
TMDL	Total Mean Daily Load
TSS	Total Suspended Solids
UMC	Upper Muddy Creek
USEPA	Unites States Environmental Protection Agency
UV	Ultra-Violet
WBMCI	West Branch Mill Creek Interceptor
WIB	Water in Basement
WSE	Water Surface Elevation
WWIP	Wet Weather Improvement Plan
WWT	Wet Weather Test
WWTF	Wet Weather Treatment Facility
WWTP	Wastewater Treatment Plant
2YES	Two Year Effectiveness Study

Appendix B

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